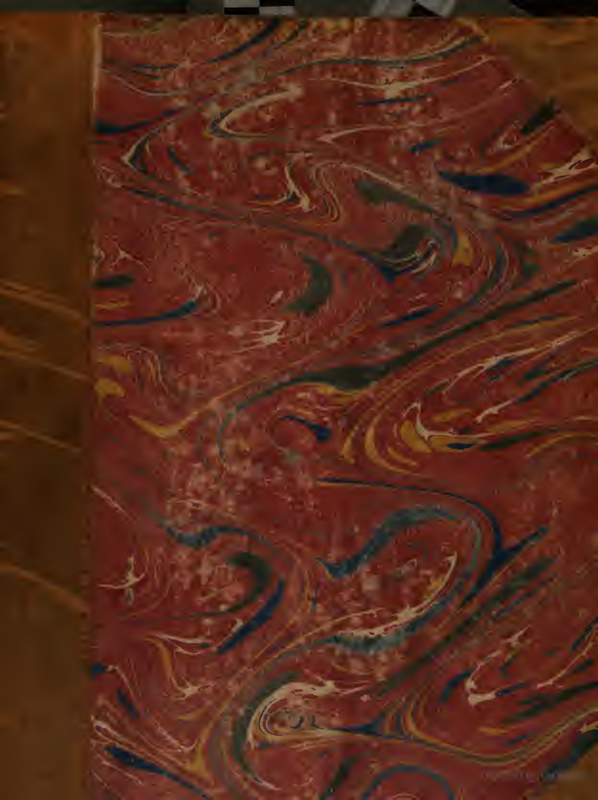

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THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE:

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S.

VOLUME IX.—1864.

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ADDRESS TO OUR READERS.

On commencing a new year and a new volume, we may be excused for printing once more a short statement of our aims and objects. The Chemical News was started four years ago, with the purpose of supplying the chemist with the earliest information on the results of laboratory investigations in pure science; the technical chemist with the practical applications of the science to his various occupations; and the medical profession and pharmaceutists with every novelty of interest relating to the materia medica, toxicology, and pharmacy. These are the objects we shall still keep in view, and steadily pursue. All the information of importance we can collect from European and American sources will be regularly supplied; original researches, and articles on matters which may attract particular attention, will be frequently published; reports of the proceedings of such scientific societies as possess especial interest to the chemist will receive the earliest insertion, and works relating to chemistry an early notice. Specifications of all patents in applied chemistry will be reviewed as soon as they are made public. In this way we hope to keep our subscribers *au courant* with the progress of pure and industrial chemistry all over the world.

In like manner we seek to afford the pharmaceutical chemist and druggist every information necessary to assist him in the practical and scientific prosecution of his occupation. Nor are the political interests of the profession altogether overlooked or neglected. The Chemical News is the organ of no society, and is, therefore, free to urge reform wherever it may appear needed, and to encourage every effort to promote the general interest.

The present year will be fraught with interest to the chemist and druggist. A national Pharmacopœia is about to appear of more important a character than any which has issued from the College of Physicians. This work will receive our earliest attention. Again, the rights of chemists and druggists are seriously threatened; and it will be necessary for the majority to combine in order to defeat any attempt of the Medical Council to deprive them of their privileges, as well as to secure the exemption from serving on juries, which has already been conceded to a section. To promote these objects we shall render every possible aid.

The thorough organisation of the trade should be completed as early as possible, and the machinery is fortunately ready by which this can be effected. The United Society of Chemists and Druggists offers the means by which the entire body may operate in concert. We say this in no spirit of opposition to the Pharmaceutical Society. That society voluntarily closed its doors to the majority of the trade some years ago, and now can be in nowise astonished that, at the present crisis, some other organisation should be found necessary.

But it must never be forgotten that the occupation of a chemist and druggist has a scientific as well as a commercial aspect; and we are glad to have the opportunity of recommending to our readers an organisation which has for its object "the encouragement of pharmaceutical research." The British Pharmaceutical Conference offers the means by which every one who will interest himself in the improvement of pharmacy can be brought into communication with others similarly disposed, so that all may work in concert for the common good. We heartily commend the Conference to the notice of our readers. It has been organised on a thoroughly catholic basis, and has for its sole object the promotion of knowledge.

In conclusion, we may add that it is our intention to publish occasional courses of lectures, and popular papers, on different branches of the science; and it is to be hoped that our more recondite readers will look with favour on these attempts to diffuse more generally a knowledge of chemistry, and so, we hope, stimulate a desire for a more profound acquaintance.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Contributions to the History of Thallium,
by William Crookes, *F.R.S.*

Oxalate of Thallium.—This salt is readily prepared by boiling together equivalent quantities of carbonate of thallium and oxalic acid, in just sufficient water to dissolve the product when hot. Upon cooling, oxalate of thallium crystallises out in the form of small prisms, brilliantly white and lustrous. It is not very soluble in water, and is insoluble in alcohol. One hundred parts of boiling water dissolve 9·031 parts of the salt; and the same quantity of water at 60° F. dissolve 1·443 parts. One part of the oxalate, therefore, requires 11·07 parts of boiling water, and 69·27 parts of cold water to dissolve it. M. Kuhlmann has ascribed to the neutral oxalate of thallium the somewhat improbable formula, C_4TlO_8; but several closely concordant analyses have shown me that this salt has the normal constitution of neutral oxalates. The method adopted for analysis is very simple, and gives remarkably accurate results. A weighed quantity, which had been dried over sulphuric acid, was gradually heated in an air bath to an increasing temperature, the weight being taken from time to time. At 230° F. a trace of hygroscopic moisture was driven off, and the oxalate then bore a temperature of 400° F. without further change. At 480° F. it began to discolour slightly, but it was found to have lost scarcely any appreciable weight. Pure concentrated hydrochloric acid was afterwards poured over the crystals; slight heat was evolved, and in a few minutes they were converted into a porous, spongy mass of chloride. The excess of acid was evaporated off over a water bath, and the residue was heated to 400° F. for ten minutes. More hydrochloric acid was then poured on, and the evaporation and heating were repeated. This was performed until no alteration of weight took place, the final heating being in an air bath at 500° F. As oxalic acid is entirely dissipated by exposure to a temperature of 320° F., the above treatment effectually removes this acid. Many experiments have satisfied me that chloride of thallium will bear a temperature of 500° F. without any loss of weight; at a slight increase of heat the chloride suddenly fuses to a thin brown liquid, white vapours being simultaneously evolved.

Analyses conducted in the above manner gave the following percentages of metal in this salt:—

82·298
82·274
82·230
82·206

Mean 82·252

The formula C_2TlO_4 requires 82·186 per cent. The neutral oxalate of thallium has, therefore, the normal composition. It contains no water of crystallisation.

Binoxalate of Thallium.—Upon mixing together two equivalents of oxalic acid to one of carbonate of thallium, and boiling, the binoxalate is deposited, on cooling, in the form of large plates, having a pearly lustre. The crystals were purified and analysed in the same way as the neutral oxalate. Upon exposure for 1¼ hours to a temperature of 270° F., the crystals became opaque, and were found to have lost 3·61 per cent. of water. Further heating did not increase this loss. The percentage of thallium in this dried salt was found to be 69·341. The formula C_4HTlO_8 requires 69·520 per cent. of metal.

The amount of water present in the crystallised binoxalate did not correspond in my analyses to a definite number of equivalents. The mean percentage obtained was 3·61. One equivalent of water in the binoxalate would require a loss of 2·99 per cent., whilst two equivalents of water would correspond to 5·80 per cent. The method of analysis was such as to render the probable error of manipulation insignificant; and the closely concordant results obtained in the estimating the thallium in the dried salt prove that the error was in the amount of water originally possessed by the binoxalate when taken for analysis. It had been dried for thirty-six hours over sulphuric acid, and it is not unlikely that it may have slightly effloresced. An estimation of the water of crystallisation, in a specimen taken out of the mother liquor, and merely dried by pressure between blotting paper (containing, therefore, a little free moisture), gave results corresponding to a little more than two equivalents of water. I am, therefore, justified in assuming that the formula for the crystallised binoxalate of thallium is

$$C_4HTlO_8 + 2Aq.$$

It is strongly acid to test paper, and is much more soluble than the neutral oxalate, requiring less than its own bulk of boiling water to dissolve it. At 60° F., 100 parts of water dissolve 5·338 parts of the anhydrous salt, equivalent to one part of the salt in 18·73 parts of cold water.

On Cæsium.

Separation from Rubidium.—Bunsen[*] has made further investigations on this rare element. He could not apply Allen's method to the preparation of pure cæsium compounds because of the small quantity of the element obtainable from the sources at his command. He discovered that cæsium could be separated from rubidium by another plan, which is as follows:—In a mixture of pure RbCl and CsCl the Cl is determined, and from its amount that of Rb is calculated. The chlorids are converted into carbonates, and to the latter salts a little more tartaric acid is added than is necessary to produce neutral tartrate of cæsium and bitartrate of rubidium. The mixture dried and pulverised is brought upon a funnel, whose neck is stopped by a small filter, and the whole is placed in an atmosphere saturated with moisture. The neutral cæsium salt deliquesces, and passes the filter, while the acid rubidium salt remains behind.

Equivalent.—The cæsium tartrate was converted into chlorid, and the latter was purified from traces of KO and LiO, which it acquired from the tartaric acid, by conversion into platin-chlorid, washing, &c. This operation was repeated six times, the salt being each time analysed. The last three results coincided very closely, and, from their average, the equivalent 132·99 was deduced, which agrees with the number obtained by Johnson and Allen, viz., 133·03, and fully authorises the use of the round number, 133, as expressing the combining proportional of this element.

Deliquescence of CsCl.—Bunsen further maintains the accuracy of his original assertion that CsCl is deliquescent. Johnson and Allen[†] had stated that it was "not only not deliquescent, but scarcely hygroscopic." The observations of both are entirely correct for the circumstances under which they were made. We have since observed pure CsCl to deliquesce in a few moments on an August day; while at this writing, September 24, the same specimen has been exposed all night to the air in a room with open windows, temperature 55° F., and is in appearance perfectly dry. Bunsen rightly remarks that "Johnson and Allen appear to have made their experiments in a comparatively dry atmosphere, in which, as is known, many deliquescent salts are unaltered, and, therefore, overlooked the deliquescent character of CsCl." The experiments of Johnson and Allen were made in the cloudy and foggy, but cold weather of November,—weather which is commonly designated as *damp*, but the real moistness of the atmosphere they only judged of from sensation.

CsCl much resembles urea in its hygroscopic relations, The latter substance is stated by most recent authors, including those who have had occasion to observe it especially, to be unaltered in the air. Thus Lehmann, "Physiological Chemistry;" Gorup Besanez, "Zoochemische Analyse;" Mitscherlich, "Lehrbuch;" Gerhardt, on authority of Pelouze, "Traité de Chimie Organique;" and Neubauer, "Analyse des Harns," assert that it is unchanged by exposure to the air. Gorup Besanez, "Lehrbuch der Physiologischen Chemie," 1862, states that it is "permanent in the air, but rapidly absorbs moisture." Gmelin mentions that "according to earlier statements it deliquesces in moist air." We have repeatedly observed that in very moist air urea rapidly deliquesces, though usually, except in summer weather, it is not visibly affected by atmospheric moisture.

Spectrum of Cæsium.—Johnson and Allen, in the paper above referred to, observed that "Kirchhoff and Bunsen, in the figure given by them (*Pogg. Ann.*, 1861, and *Fres. Zeitschrift für Analyt. Chemie, Heft* 1, 1862), represent eleven lines. We find without difficulty seven more lines, and observe further that some of those figured by Kirchhoff and Bunsen are not mapped in their correct position."

In relation to this, Bunsen remarks, "We regret that Messrs. Johnson and Allen appear to have neglected to make an accurate comparison of their spectrum with ours, otherwise they would have easily convinced themselves that the lines given by them agree with ours as closely as is possible; that, on the other hand, three lines are figured on our plate which do not occur at all in the cæsium spectrum. These lines have been printed on a number of lithographs by fault of the lithographer, in consequence of a misunderstood proof that was not sent to us for revision, and lie near and to the right of the lines designated by Johnson and Allen as VI., X., and XV."

Johnson and Allen could but conclude that the coloured plate in *Poggendorff's Ann.*, accompanying the paper of Kirchhoff and Bunsen, was a copy of their spectrum as far as the important, *i.e.*, the characteristic and brilliant lines were concerned. They are therefore scarcely more in fault in having "neglected to make an accurate comparison" than Kirchhoff and Bunsen are in permitting incorrect spectrum plates to be circulated. Fresenius uses the uncorrected chromo-lithograph in the new edition of his "Qualitative Analyse," and we have never yet had the good fortune to see the lines of this element correctly mapped on any coloured print.

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[*] *Pogg. Ann.*, cxix., 1.

[†] Chemical News, vol. vii., p. 110.

Bunsen notices at length the inaccuracies of the diagram of Johnson and Allen, which, as the latter stated distinctly, was intended to give approximatively the position of the lines on Kirchhoff and Bunsen's scale, and which from the construction of the spectroscope they employed would not be exact.

The remark of Johnson and Allen that their "line II., nearly coincident with a lithium of Kirchhoff and Bunsen, and not figured by them, is as bright as their γ cæsium, our VI. (?)"—Bunsen passes over without notice. The observation is certainly not an unimportant one, for any person occupied in preparing the new alkalies is likely to be embarrassed by a line that in small instruments is practically coincident with a lithium, if it be not credited to cæsium by the authorities.

Johnson and Allen rightly state that "the yellow line VIII. is hardly less characteristic of the spectrum of pure cæsium than the two blue lines. It also is nearly as distinct as any of the green lines when sodium is not present in too large quantity, and is much more readily made out than the extreme red line δ of rubidium." This line was wanting in the original spectrum plate of Kirchhoff and Bunsen. Chemists will be glad that Bunsen has now given, in connexion with the paper we refer to, a diagram of the spectra of all the alkalies and alkaline earths, as well as of thallium, which is quite complete, and which, by following his simple directions, is readily and exactly comparable with the spectra of any instrument. In this he figures sixteen lines for cæsium.—*S. W. J., in American Journal of Science,* xxxvi., 413.

Preparation of Chloropicrin, by SAMUEL PRIESTLEY.

THIS substance, which has usually been prepared by distilling picric acid with hypochlorite of lime, may be prepared from methylic alcohol directly—a fact which establishes beyond doubt the connection of chloropicrin with the methyl series.

I succeeded in obtaining the substance in the following manner:—

Bleaching powder is introduced into a flask, with as much methylalcohol as will form a paste. After mixing the materials, the flask must be placed in a shallow basin of cold water, in order to prevent the volatilisation of the spirit by the heat disengaged.

When the chemical action has subsided, nitric acid is added carefully and by small portions at a time, allowing the action to subside each time, the flask remaining still in the water.

The whole, when dissolved, is submitted to distillation. During the distillation a gas is evolved, which burns with a green flame, and may be collected over water. It is probably chloride of methyl, but I have not examined it further. These product which collects in the receiver appears to be a mixture of chloroform, chloropicrin and wood-spirit. These substances are afterwards separated by distillation; the chloropicrin, having a higher boiling point, remains behind.

In the actual reaction it is very probable that chloroform is first produced, and that the nitric acid reacts according to the following equation:—

$$\mathrm{CHCl_3} + \left.\begin{matrix}\mathrm{H}\\ \mathrm{NO_2}\end{matrix}\right\}\mathrm{O} = \mathrm{CNO_2Cl_3} + \left.\begin{matrix}\mathrm{H}\\ \mathrm{H}\end{matrix}\right\}\mathrm{O}^*$$

The odour and oily appearance of the substance leave no doubt as to its true chemical nature.

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[*] Carbon = 12 Oxygen = 16.

TECHNICAL CHEMISTRY.

Account of an Oil-Lamp Furnace, for Melting Metals at a White Heat, by CHARLES GRIFFIN.

I HAVE been for some time engaged in experiments on the construction of chemical lamps. My object was to discover a method by which chemists and metallurgists, who have occasion to melt metals at a white heat, but who happen to have no command of coal-gas, may be enabled to accomplish their purpose by other agents. After many trials, I have contrived an oil-lamp which is not only as powerful in action as the best gas furnaces, but almost rivals them in handiness and economy.

Description of the Apparatus.—The oil-lamp furnace is represented in perspective by Fig. 1, and in section by Fig. 2. It consists of a wick-holder, an oil-reservoir, and a fire-clay furnace. To these must be added a blowing-machine for the supply of atmospheric air.

The oil-reservoir is represented at letter *a*. It is made of japanned tinplate, mounted on iron legs, and fitted

FIG. 1.

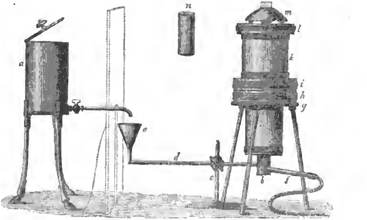
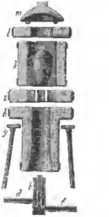
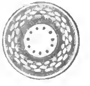


FIG. 2.



with a brass stopcock and delivery-tube. Its capacity is a little more than a quart. The wick-holder is represented at letter *b*, and the upper surface of it by the separate figure c. The wick-holder and the oil-reservoir are consequently detached.—*d* is a tube which brings oil from the funnel *e*, and *f* is a tube to be placed in connexion with the blowing apparatus. The wick-holder contains three concentric wicks, placed round the multiple blowpipe c, which is in communication with the blowing tube *f*.

The crucible furnace consists of the following parts:—*g* is an iron tripod; *h* is a flue for collecting and directing the flame. This flue is of such a width, that when the wick-holder *b* is pushed up into it until the top of the wick is level with the top of the clay cone, there remains a clear air-space of about ⅛th inch all round between the wick-holder and the cylindrical walls of the flue.—*i* represents a fire-clay grate, having three tongues, shown by *i*, the separate figure of its upper surface. These tongues support the crucible, without stopping the rising flame.—*k* is a fire-clay cylinder, which rests upon the grate *i*, and encloses the crucible, forming, in fact, the body of the furnace. Of this piece there are three sizes: the smallest is of 3 inches bore, and works with crucibles that do not exceed 2¾ inches diameter; a middle size, 4 inches bore, for crucibles not exceeding 3½ inches diameter; the largest size, 5 inches bore, for crucibles not exceeding 4¾ inches diameter. This piece being heavy, is provided with handles, as represented in the following figure. The walls of these cylinders are from 1 to 1½ inch thick.—*l* is a flat plate of fire-clay, with a hole in the centre, used to cover the cylinder *k*, so as to act like a reverberatory dome; *m* is a cover which prevents loss of heat from the crucible by radiation, but gives egress to the gaseous products of the combustion of the oil; *n* is an extinguisher to put over the wick-holder when an operation is ended; and o is a support for the wick-holder.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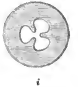
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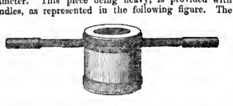

No chimney is required.

Management of the Oil-Lamp Furnace.—The apparatus is to be arranged for use as it is represented by Fig. 1. The cylinder *k* is to be selected to fit the crucibles, and that to suit the quantity of metal that is to be melted. 1 lb. of iron requires the smallest of the three cylinders described above; 1½ lb., the middle size; 5 lbs., the largest size. The air way between the crucible and the inner walls of the cylinder should never exceed ¾ inch, nor be less than ⅛ inch.

The cotton wicks must be clean, and be trimmed a little below the level of the blowpipe *c*. If properly managed, they do not readily burn away, but can be used for several fusions. The reservoir should be filled with oil for each operation. The proper sort of oil for use is the more volatile kind of mineral oil, of the specific gravity of ·750, which is now easily procurable at about 3s. per gallon. The variety known by the commercial name of turpenzine answers well. The combustion of a quart of this oil, costing 9d., gives heat sufficient to melt 5 lbs. of cast iron. Probably the lighter kinds of paraffin oil may be suitable, but I have not had an opportunity of trying them. Liquids of the alcohol class, spirits of wine, and pyroxylic spirit can be used, but they are less effective and more expensive than turpenzine. Care must be taken not to spill the oil on the table or floor, and not to decant it carelessly in the neighbourhood of a light, because atmospheric air strongly charged with the vapour of these light oils is explosive. When the oil is burnt in the furnace, in the manner described below, there is no danger. During an operation, a wooden screen, as represented by the dotted lines in figure 1, should be placed between the oil reservoir and the furnace, to prevent the vaporisation of the oil by radiant heat.

As the wick-holder *b* and supply-pipe *d* contain only about one fluid ounce of oil, the oil must be run continuously, during a fusion, from the reservoir *a* into the funnel *e*, in order that the cotton may be always flooded. The success of the fusion depends upon the due supply of oil, to which point the operator must pay attention. At the commencement of a fusion, the oil must be run from the reservoir until the surface of the oil in the funnel has a diameter of about an inch. The wicks will then be flooded, and a light may be applied, and a gentle blast of air set on. The oil immediately sinks in the funnel; and the stopcock must be opened, and so regulated as to keep the oil barely visible at the bottom of the funnel. If too much oil is supplied, it immediately rises in the funnel, and simultaneously overflows the wick-holder. Too much vapour is then thrown into the furnace, and the heat is immediately lowered, especially at the beginning of an operation, before the fire-clay portions of the furnace are well heated. If, on the contrary, too little oil is supplied, the wicks burn, and the operation is spoilt. The demand of the wick-holder for oil depends upon the condition of the furnace and the character of the fusion in progress. When the lamp is newly lighted and the furnace cold, the oil should be passed slowly, in distinct drops; but, as the furnace becomes hot, the rapidity of the supply of drops should be increased; and, finally, when the furnace is at a white heat, the oil should be supplied in a thin continuous stream. When the fusion to be effected is that of only a small quantity of metal, such as 1 lb. of iron, a rapid supply of drops of oil is sufficient even to the close of the operation. At that rate, the burner consumes about 1¼ pint of oil in an hour. When the fusion to be effected is that of 4 lbs. or 5 lbs. of iron, and the large furnace is in action and has been brought to a white heat, the supply of oil must be, as stated above, in a thin continuous stream, and the operation will then consume 2 pints of oil in the hour. And here it requires remark that, with that continuous supply, when the furnace is large and is at a white heat, the oil does not rise in the funnel, being instantaneously converted into gas at the mouth of the burner, and thrown up in that state into the furnace for combustion. The operation, indeed, consists, at that point, of a rapid distillation of oil-gas, which is immediately burnt, in the presence of air supplied at a suitable pressure by a dozen blowpipes, in effective contact with the crucible to be heated.

The flame produced in this furnace is as clear as that produced by an explosive mixture of air and coal-gas. It is perfectly free from smoke; and the unconsumed vapours which occasionally escape with the gaseous products of the combustion are even less unpleasant to smell and to breathe in than are those which are usually disengaged by a blast gas furnace, or by an ordinary lamp fed with pyroxylic spirit.

The contents of a crucible under ignition in this furnace can at any moment be readily examined, it being only necessary to remove the pieces *l* and *m* with tongs, and to lift the cover of the crucible, during which the action of the furnace is not to be interrupted.

When the operation is finished, the blast is stopped, the stopcock is turned off, the oil-reservoir is removed, the wick-holder is lowered on the support o, withdrawn from the furnace, and covered with the extinguisher *n*. The quantity of oil which then remains in the lamp is about one fluid ounce.

Power of the Oil-Lamp Furnace.—The furnace being cold when an operation is commenced, it will melt 1 lb. of cast iron in 25 minutes, 1½ lb. in 30 minutes, 4 lbs. in 45 minutes, and 5 lbs. in 60 minutes. These results have been obtained in my experiments. When the furnace is hot, such fusions can be effected in much less time; for example, 1 lb. of iron in 15 minutes. It need scarcely be added that small quantities of gold, silver, copper, brass, German silver, &c., can be melted with great ease, and that all the chemical processes that are commonly effected in platinum and porcelain crucibles can be promptly accomplished in the smallest cylinder of this furnace; and, in the case of platinum vessels, with this special advantage, that the oil-gas is free from those sulphurous compounds, the presence of which in coal-gas frequently causes damage to the crucibles.

Requisite Blowing Power.—The size of the blowing machine required to develop the fusing power of this oil-lamp furnace depends upon the amount of heat required, or the weight of metal that is to be fused. For ordinary chemical operations with platinum and porcelain crucibles, and even for the fusion of 1 lb. of cast iron in clay or plumbago crucibles, a blowing power equal to that of a glass-blower's table is sufficient, provided the blast it gives is uniform and constant. But the fusion of masses of iron weighing 4 or 5 lbs. demands a more powerful blower, such as is commonly used in chemical laboratories for the supply of air to blast furnaces when fed by gas or coke. The highest power of the oil-lamp furnace depends, indeed, upon the power of the blowing-machine that is to be used with it. Much more than 5 lbs. of iron can be melted by the gas which this oil-lamp is capable of supplying, provided a sufficiently powerful blowing-machine supplies the requisite quantity of air. When more than a quart of oil is to be rapidly distilled into gas, and the whole of that gas is to be instantly burnt with oxygen, it is evident that effective work demands a large and prompt supply of air.

Cost of the Oil-Lamp Furnace.—As in all practical matters of this sort the cost is a main question; it may be useful to state that the price of this apparatus, complete, without the blowing-machine, but including every other portion necessary for heating crucibles up to the size sufficient to fuse 1 lb. of cast iron, is one guinea; and that with the extra furnace-pieces for crucibles suitable for 5 lbs. of iron, or any intermediate quantity, the cost is a guinea and a half.

PHARMACY, TOXICOLOGY, &c.

On Spiritus Ammoniæ Aromaticus,
by W. T. Fewtrell, *F.C.S.*

Aromatic spirit of ammonia, commonly called sal volatile, is directed by the Pharmacopœia to be made with such proportions of carbonate of potash and chloride of ammonium as it is supposed will produce a neutral carbonate of ammonia in solution in a mixture of spirit of wine and water, with flavouring substances; but, as sometimes happens with the most meritorious designs, it would seem that the purpose intended is not always fulfilled. It should have been premised that it is with the spirit of the Pharmacopœia of 1851 we are dealing; and it now almost requires an apology for noticing this article. Whatever apology, however, may be necessary, has been recently supplied by a contemporary. The formula about to be introduced by the British Pharmacopœia will be noticed in due time: for the present we return to the Pharmacopœia of 1851.

In this work we find the following recipe:—Take of hydrochlorate of ammonia, six ounces; carbonate of potash, ten ounces; cinnamon and cloves, bruised, of each two drachms and a half; lemon peel, five ounces; rectified spirit and water, of each four pints; mix, and distil six pints. The result of this process is stated by Pereira and Royle to be the production of chloride of potassium, and neutral carbonate of ammonia, which latter distils over with spirit, water, and essential oils. How far this statement is really true, and what the distilled product contains, remain to be seen.

The Pharmacopœia continues—"*Hujus pondus specificum est*"—("formula," as a recent novelist writes)—"918."

We have here again an invariable specific gravity asserted, which in practice it is found almost impossible to secure.

We are, of course, well aware that sal volatile is often made by private formulæ; and that some which enjoy the highest repute are made by other than the Pharmacopœia process. We do not suppose that this fact has tended to swell the records of mortality greatly; but we must not be supposed to defend any deviations from the authorised formulæ.

In some instances, respectable druggists keep two preparations: one made according to the Pharmacopœia for dispensing; and another made for retail, more pungent, as suiting better the public taste.

We confine our notice to the preparation made exactly according to the Pharmacopœia, and the question to be determined is, in what state is the ammonia in that preparation? Is it really monocarbonate, or does there exist, in a genuine Pharmacopœia preparation, any free ammonia?

In order to determine this point, four times the proportions of the Pharmacopœia were distilled, so as to produce an article made on a manufacturing scale. The distillation was effected in an earthenware retort;

Spt. Am. Aromaticus.

and, as the use of a worm are liable to inconveniences, the product was condensed in two globular condensers set perpendicularly in separate vessels of water, and connected by means of an earthenware tube. The vessels were kept cool by a current of water passing in at the bottom and out at the top.

Small samples of every half-gallon of the product were taken as it came over. For the information of those practically unacquainted with the process we give a brief description of these separate portions:—

No. 1. Sp. gr. ·862, was a clear bright liquid, which deposited crystals. The odour was pungent, but only faintly aromatic.

No. 2. Sp. gr. ·870, was a clear bright liquid, which deposited crystals. The odour was pungent, but only faintly aromatic.

No. 3. Sp. gr. ·874, was a clear bright liquid, which deposited crystals. The odour was pungent, but only faintly aromatic.

No. 4. Sp. gr. ·930, was also a clear liquid, but deposited no crystals. The odour was less pungent, but still only faintly aromatic.

No. 5. Sp. gr. ·988, was a slightly turbid liquid, with a faintly ammoniacal odour, but much more aromatic.

No. 6. Sp. gr. 1·0002, was more turbid, very slightly ammoniacal, but still more aromatic, the smell of cloves predominating.

No. 7. The whole mixed together and filtered, was a clear and, at first, colourless liquid, having the specific gravity ·938.

The first point in the chemical examination was to determine the composition of the crystals deposited in Nos. 1, 2, and 3. They were analysed by Mr. Crookes, and were found to consist of bicarbonate of ammonia. Crystals, similarly obtained, had previously been analysed by Mr. C. H. Wood, who arrived at the same result. The liquid portion of No. 3, in which these crystals were deposited, was next examined, with the following results:—

Total ammonia in 100 parts . . .	2·312
Carbonic acid	1·101

Calculated for monocarbonate of ammonia, this result shows an excess of the alkali equal to 1·011 per cent. So far, then, we have bicarbonate of ammonia deposited (on account of its insolubility in alcohol), and a considerable amount of uncombined ammonia in the solution.

We may pass over the composition of the other solutions, and now only quote that of the finished product, in which, of course, the crystals deposited in Nos. 1, 2, and 3 were dissolved. In this liquid the proportions were as follows:—

Total ammonia in 100 parts . . .	2·120
Carbonic acid	1·473

Calculated as before, for monocarbonate of ammonia, the results show the presence of free ammonia to the extent of 0·58 per cent. It follows, that aromatic spirit of ammonia, made in strict accordance with the directions of the Pharmacopœia, contains free ammonia.

This fact, perhaps, is not difficult to account for. The reason for it will probably be found in the known instability of the salts of ammonia in a state of vapour. It would seem that what Deville calls disassociation, and what Messrs. Wanklyn and Robinson regard as decomposition, takes place with carbonates of ammonia[*] at comparatively low temperatures; and that, before the constituents can again unite, a portion of the carbonic acid makes its escape.

Leaving, however, this part of the question to be settled by more competent authority, we may repeat, that this experiment shows that aromatic spirit of ammonia, made strictly according to the Pharmacopœia, may contain free ammonia, and that its specific gravity may be as high as ·938. The difference between this number and ·918 is indeed small; but we have seen that differences quite as small have been made use of to fix an undeserved stigma on the character of a conscientious manufacturer.

One other point deserves a primary notice. It is said that if only the exact quantity ordered by the Pharmacopœia is drawn off, the sal volatile will remain without colour. In the experiments recorded, the exact quantity was drawn off, and now, after little more than a month, the liquid, which at first was colourless, has become decidedly brownish.

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture I.—*Thursday, December 10, 1863.*

I may, Ladies and Gentlemen, preface these lectures by a few remarks concerning the lectures themselves. They have been established by a Dr. George Swiney, who, some years ago, left a sum of money to be devoted to that purpose. That sum is invested in the trustees of the British Museum; and the lectureship, which can only be held for five years, must be held by a graduate of the Medical faculty of the University of Edinburgh. The trustees have been pleased to confer upon me the honour of Swiney lecturer for the ensuing five years.

We will now proceed, if you please, at once with our subject.

Geology has for its object the study of the nature and mode of formation of the exterior of the earth, which alone is accessible for investigation. That exterior is usually designated the "crust" of the earth, an expression which implies necessarily that the interior is not solid, but is in a state of greater or less liquidity. The received hypothesis is, that our planet was once molten, and that in the lapse of ages it has gradually cooled down, and has become solid on its surface. On the present occasion, I do not propose to examine the foundations of this hypothesis. I use the word "crust" simply because it is a term perfectly well understood, and generally accepted, and not because it is any exponent of my belief on this subject.

We are acquainted altogether with about sixty elementary bodies—simple substances, as chemists term them—which cannot be divided into any simpler forms of matter; and it is really remarkable how few constitute the great bulk of the earth's crust—not more than five. These five are silicon, aluminium—the basis of alumina, calcium—the basis of lime, and oxygen, and carbon. The states of combination in which they occur are silica, that is, silicon combined with oxygen; alumina, that is, aluminium combined with oxygen; and lime, or calcium combined with oxygen; and this lime is, for the most part, or, at all events, to a very large extent, in combination with carbonic acid, constituting marble and limestone in its various forms. Perhaps next in abundance we may rank magnesium; but on this point I cannot speak with anything like certainty, and I should be very unwilling to commit myself to a definite numerical statement on the subject. We are now speaking, bear in mind, of the solid crust of the earth. Then, perhaps, would come hydrogen, iron, sodium, potassium, manganese, chlorine, sulphur, and phosphorus. The hydrogen to which I allude is that existing in combination with oxygen in the form of water, and present in a state of solid combination in all clay. It is not there, as chemists term it, as hygroscopic water, water simply of moisture, which can be expelled at a low temperature, but it is there in a state of actual solid combination, and we may, therefore, consider it to be one of the constituents of the solid crust of the earth.

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[*] A recent experimenter, whose name and the reference to whose paper at the moment escapes us, asserts that when a solution of chloride of ammonium is boiled for some time, the liquid becomes acid from loss of ammonia.

The geologist everywhere meets with problems of the highest interest which chemistry alone can solve; yet it is somewhat surprising that in this country of geologists the application of chemistry to the solution of geological phenomena should hitherto have received so small a share of attention. Geology, it must be admitted, is a most comprehensive science, and, to be studied as a whole, requires knowledge so varied and so extensive that there is, perhaps, no living geologist who can be said to have mastered the subject in all its details. It demands more than a superficial acquaintance with physics, mechanics, inorganic chemistry, mineralogy, comparative anatomy, and botany. Where is the man who possesses this combination of acquirements? Not a few persons have attained the reputation of geologists who have either been ignorant of the great foundations of the philosophy of geology, or have had a very slight knowledge of the subject. To know and to remember the order of superposition of rocks, and to be able to recognise the fossils which they respectively contain, does not, I apprehend, entitle a man to rank as a philosophical geologist. As well might a taxidermist lay claim to the title of zoologist, or an ornithologist to the title of botanist. The conquests which remain to be achieved in geology will, doubtless, result from the special study and application of the various sciences which essentially compose the great science of geology, and there is assuredly no line of investigation which promises richer fruit than that relating to chemistry.

Having made these preliminary remarks, we will, if you please, proceed at once to examine the subject of this morning's lecture. That subject is silicon, perhaps the most abundant, or, certainly, one of the most abundant elements in the solid crust of the earth. This silicon has only recently been investigated in anything like a satisfactory manner. It exists in, and is the foundation of silica in its various forms. Silica exists in the well-known form of quartz, and consists of silicon combined with oxygen. In sand and in all clay, and in igneous rocks of various kinds, it is an essential constituent. In fact, it is everywhere. This silicon, when once united with oxygen, requires an extraordinary amount of affinity, or the exercise of an extraordinary force to *detach* it therefrom.

Silicon exists in three distinct states, the amorphous or formless state, in the graphitic state, and in the state of crystallised octahedral silicon. I have here placed before you some very fine specimens of silicon, for the loan of which I am indebted to Mr. Matthey, of Hatton Garden. They are as fine as can well be seen. I shall not attempt to describe the substances which are prepared from silicon, as that would occupy too much of our time.

In its three states, silicon differs considerably. In the amorphous state it occurs in the form of a chocolate brown powder. In the graphitoidal state it is exactly like graphite, or very similar, occurring frequently in small hexagonal plates, as produced in the process for making aluminium. Then we have the octahedral form, the same form and the same crystalline system as that to which the diamond belongs. But here it is a most beautiful substance, of a metallic lustre, and a dark bluish grey colour, considerably more blue then ordinary graphite, and, I think, more metallic in lustre.

Silica consists, in round numbers, of about 48 parts of this silicon, and 52 of oxygen. The atomic formula adopted, and first suggested by Berzelius, is this, $Si\,O_3$, representing one equivalent of silicon combined with three of oxygen; but there are reasons for supposing that the more accurate expression is $Si\,O_2$, one equivalent of silicon combined with two of oxygen.

Now, long ago it was ascertained by Schafgotsch that silica exists in two very different states. In one state it was crystallised as quartz, having a specific gravity of 2·6. All quartz, for example, has this specific gravity, and not only quartz, but chalcedony, hornstone, and flint, and yet these present no outward sign of crystalline structure. It is, however, maintained by Rose, and with some plausibility, that they consist of an aggregation of excessively minute crystals. He designates these forms of quartz as *crystalline*, in contradistinction to the ordinary form of rock crystal, which is distinctly *crystallised*. We have, then, crystalline quartz, and this apparently non-crystallised form of quartz which I have just mentioned, chalcedony and the like, of the high specific gravity 2·6.

Now, there is another form of silica in which the specific gravity never exceeds 2·3. It ranges from 2·2 to 2·3, and is never higher than that. This is what is termed amorphous, apparently non-crystalline silica; and these facts, you will perceive directly, have or may have a very important bearing on certain geological considerations of the highest importance. All the crystallised silica of the high specific gravity polarises light. The amorphous silica of low specific gravity does not polarise light. The distinctly crystallised silica which we have here in the form of quartz, when pulverised, reduced to extremely fine powder by trituration and levigation, does not differ chemically in any sensible respect from the powder of the apparently amorphous form of silica, flint, chalcedony, and the like. Both resist the action of boiling alkaline solutions, whereas the amorphous silica is copiously and readily dissolved by such solutions. The crystallised silica is produced in the wet way, and, so far as we know, only in the wet way. By the wet way, I mean through the agency of liquids, never by fusion at a high temperature. The late M. Senarmont, who has devoted considerable attention to the artificial formation of minerals, made microscopic crystals of quartz by dissolving silica in the nascent state, that is, at the moment of its separation from a state of combination, in very dilute hydrochloric acid, and then exposing that solution in a closed tube to a temperature of between 200 and 300 centigrade. These crystals he found to be precisely similar in crystalline form and all other essential respects to those actually occurring in nature, being in the form of six-sided prisms, terminated by the usual pyramids found in crystallised quartz, and having hexagonal faces presenting the transverse striæ which we so constantly see on these crystals. Here, then, is a clear experiment proving the production of crystallised silica by the agency of liquids, exactly similar, in all essential respects, to the rock crystal of nature. It is true that the crystals were very small; but that in no way affects the truth of the conclusion to which I shall draw special attention by-and-by; but all this crystallised silica, of which you have such a fine specimen before you, has been produced in nature by the agency of liquids, and not by fusion at a high temperature, ~~Sorby~~ obtained crystalline Daubrée silica. I use the word *crystalline*, because it was not distinctly *crystallised*. His specimens he examined carefully by the microscope, and he was able distinctly to recognise the forms. He first obtained this form by passing chloride of silicon into a tube along with the vapour of water, but he afterwards procured still more distinct crystals by decomposing glass at a high temperature by the agency of water. We may take an ordinary piece of glass and boil water in it for almost any length of time, without appreciably acting upon it; but if we expose ordinary glass to the action of water at a high temperature in a close vessel the result is different, and the glass is rapidly attacked and corroded. By acting upon glass consisting of silica, lime, and potash by water, at a high temperature, he obtained the well-known mineral called Wollastonite, which is a silicate of lime; and he obtained perfectly transparent crystals of quartz, not less than two millimetres in length. Here, then, is a distinct experimental proof of the formation of characteristic crystals of quartz, similar to those occurring in nature, by the agency of water, simply at a high temperature, upon silicate of lime and potash, or soda, as the case may be. That is immaterial. It is a fact that the heavy compact and the crystallised silica often occur together, and hence we may infer the similarity of the conditions of their formation.

I am sadly afraid that I may lead to some confusion about this crystalline and amorphous silica, and, therefore, to be quite clear, allow me to say one or two words further upon the subject. We have quartz which is distinctly, manifestly crystallised. The specific gravity of that quartz is, as I said a short time ago, very high as compared with the other—2·6. Then we have another form of silica having the same specific gravity, yet not appearing crystalline to the eye, although there are certain reasons for supposing that it may be composed of an aggregation of excessively minute crystals. Then there is the other distinctly amorphous non-crystalline variety, which has the low specific gravity of 2·3. You see there are two apparently amorphous varieties of silica. There is the chalcedony, for example, and there is the mineral called opal. If we compare that piece of common quartz with opal, they both appear non-crystalline, and they both, therefore, might be confounded under the term "amorphous;" but the term "amorphous" is restricted to this particular form of solid silica having the low specific gravity.

All attempts to crystallise silica by fusion have hitherto failed. Many experiments were made upon this subject a long time ago by means of the oxy-hydrogen blow-pipe. Silica has been distinctly fused into small globules. There is no great difficulty about that. More recently, Deville, who has paid special attention to the application of high temperatures to metallurgical purposes, has succeeded in fusing silica in considerable quantities, and he has subjected it to slow cooling, but never in a single instance has there been the slightest trace of crystallisation; and such silica—silica fused at these high temperatures—has always the low specific gravity of 2·3. You will see the bearing of that by-and-by upon the supposed formation of granite and certain other igneous rocks. If we take a piece of this crystallised quartz of a high specific gravity, and fuse it, we convert it into a substance somewhat resembling the silica of the low specific gravity, having the gravity of 2·3. Now that is apparently a small fact, but in a geological point of view it is one of the highest interest. Formerly, it was a marvel to melt a bit of platinum as big as a pin's head. Now, Deville has succeeded in melting it in a mass as big as that of which this is a model. The real piece was in the Exhibition of last year. This platinum sometimes contains silicon, and in fusion the silicon becomes oxidised, and converted into silica, and you get the melted silica swimming on the top of the melted platinum in the form of a thin, transparent, colourless liquid, so high is the temperature.

I have now to speak especially of certain important experiments, made by Gustave Rose, upon the subject of the specific gravity of silica as determined by temperature. It is a curious point that he found, that when perfectly transparent, entire rock crystal underwent long exposure, say for eighteen hours, to a porcelain furnace, in which the temperature is exceedingly high, though nothing so high as that required for the fusion of platinum—being estimated at about 2000° centigrade—there was no alteration in the specific gravity at this temperature; but when the same crystal was exposed to the same conditions of temperature, having been previously pulverised—reduced to fine powder—its specific gravity was reduced from 2·6 to 2·3. Again, he found in the case of common flint having a specific gravity of 2·591, owing to certain impurities which interposed, that by exposure to this high temperature for a long time, its specific gravity was reduced to 2·237. There, again, is another example of the influence of high temperature in reducing the specific gravity of silica in this particular state of aggregation.

We have now to consider more particularly this amorphous silica, or that form of silica to which Professor Graham has so well given the name of "colloidal, or jelly-like silica." This silica is obtained in various ways, which are very well known in the laboratories of chemists. It is obtained by the decomposition of silicates by acids. If I take a silicate of potash or a silicate of soda, which will dissolve readily enough in water, the solution of which is known by the name of water-glass, about which we have heard so much with regard to the preservation of stone and the like, and add, under certain conditions of dilution and so forth, an acid to that water-glass, the silica will immediately separate in the form of a jelly—such a jelly as I have here; it might be mistaken for a piece of ordinary jelly. Under other conditions of dilution there would be no immediate separation of jelly whatever, but the whole of the silica will be retained in solution, though it be separated from its combination with the base by the addition of a stronger acid; but, on keeping, it will ultimately gelatinise, or during evaporation, by the application of heat, the silica will be thrown down in the same jelly-like state. We will make this experiment before you, that you may see the result for yourselves. These experiments may seem very small; but, at the same time, they are extremely interesting in reference to certain geological phenomena. Here it is immediately a great lump of jelly. There is no mistake about the fact. It may be inverted without being spilled. Well, now we will try the other condition, and see if we can retain it all in solution. Sometimes things do not go quite as they ought. It depends entirely upon the degree of dilution. There it is; but still there is a large amount of water contained in the silica; and, if time permitted, we could soon render that evident by the application of heat and evaporation; but it would take more time than we can devote for the purpose. When evaporated to dryness this jelly forms a white, amorphous powder, exactly like that which I hold in my hand. This gelatinised silica, or colloidal state of silica, is produced by the action of water on a peculiar compound termed "fluoride of silicon"—a well-known compound in the laboratory of chemists. It is a gaseous compound, consisting of silicon in combination with the element fluorine, which is an essential constituent of common fluor spar. It is a perfectly transparent, colourless gas, which immediately suffers decomposition by contact with water: hence, when this gas is allowed to escape into the atmosphere, under ordinary circumstances it produces a copious white smoke, due to the formation and deposition of silica. We will endeavour to prepare it here. We have in the flask a quantity of fluor spar and sand. We mix that with sulphuric acid, and, under these conditions, the fluoride of silicon is formed, which, in passing through water, becomes immediately decomposed, depositing gelatinised silica. If we were to plunge the delivery-tube, conveying the gas, into water, the quantity of silica immediately produced would be so great as to stop up the tube, and to burst the flask. In order to avoid that effect, it is usual to place at the bottom of the vessel a quantity of mercury, over which is the water, and to let the gas escape in the mercury, and below the water. This gelatinous silica, when dry, forms an exceedingly light powder. In fact, it is in a state of the extremest possible division. As far as I know, there is no other way of making amorphous silica in such a fine state of division as this.

We will now notice the solubility of silica. And this is a subject of very high importance to geologists.

Now, in an aqueous solution of potash, for two parts by weight of solid potash in solution there is dissolved one part by weight of this extremely fine silica in fluoride of silicon. Of silicon in the state of quartz there is dissolved ·009 for two parts by weight, and of silica in the state of flint there is dissolved ·038. This difference is due simply, or, at all events, in a great measure, to a difference of aggregation. When rock crystal has been actually melted, and then pulverised, it is as soluble in this menstruum—this solvent—as the silica from the fluoride of silicon, obtained by the decomposition of water. Silica dissolves, to a certain extent, in water containing alkaline carbonates. The light variety is far more soluble than the heavy variety. An aqueous solution of carbonate of potash, or soda, for example, dissolves fifteen times more amorphous than crystalline silica. With regard to the solubility of silica in pure water, Bischoff states, that one part of silica dissolves in 769230 parts of water.

I have now to bring before your notice some results obtained by Professor Graham, which are as interesting as they are novel, and, I think, important. I allude to the phenomena of dialysis, which will possibly hereafter be found to explain many obscure geological phenomena.

Now let us see what we mean by the term "dialysis." Here is a common vessel of glass, and here is some paper termed "parchment paper," prepared in a particular way. Here is a hoop of gutta percha. The paper is tied round this hoop, or fixed in this hoop, so that you get a circular vessel, the bottom of which consists of this parchment paper. Now, into this glass vessel we may suppose we place pure water, and into the hoop vessel we will place some of that solution that we had just now—a solution of silicate of soda to which the acid has been added in such a way as not to precipitate the silica. Here is that solution. Into the hoop we will put the solution, and then place the whole on some pure water, and there leave it. What will take place? Well, in the course of time a certain proportion of the silica will pass through that membrane into the other constituents in the solution, but eventually there will remain in the floating hoop vessel, covered with paper at the bottom, a pure solution of silica. All the hydrochloric acid will be gone by virtue of the operation of that paper. The chloride of sodium, or potassium, as the case may be, will be gone—with a certain proportion of silica, it is true—and there will remain atlength a pure, limpid, colourless solution of silica.

Professor Graham has been so kind as to supply me with illustrations for this lecture, which I will now place before you. I really do not know any discovery which is of higher interest, or promises more important results, or more beautiful results, than dialysis. Here is a 5 per cent. solution of silica. The water contains 5 per cent. of silica. There is no base there to retain that silica in solution. There it is—a pure limpid solution of silica in pure water. In the course of time, if the solution has a certain strength, it will gelatinise, or, as Professor Graham calls it, pectise—form jelly. The weaker and purer the solution, the less tendency it has to gelatinise. Professor Graham expresses an opinion, that with one per cent. of silica dissolved in it, the solution might be preserved for an indefinite length of time without change.

There are some very curious properties about this solution to which I am very anxious to call the attention of geologists especially. This solution may contain as much as 14 per cent. of silica, and yet be perfectly limpid, and not in the least viscous. It may be boiled in a flask for a considerable time, and concentrated considerably without change. When heated in an open vessel a ring of insoluble silica is apt to form around the margin of the liquid, and this may soon cause the whole to gelatinise. The solution is, as I said, durable in proportion to its purity. It is not easily preserved beyond a few days unless considerably diluted. It becomes opalescent after a short time, and then the jelly separates; and once separated, it cannot be redissolved in water. When the jelly is formed suddenly it is always more or less opalescent. Here is some which has been formed slowly by Professor Graham. It is a perfect jelly, perfectly colourless and limpid, like rock crystal. If you just touch it slightly in that way you give rise to a vibratory tremor. It contracts, after a few days, even in a close vessel, and then pure water separates from it. It is a very curious fact in connection with it, that coagulation, or the separation of silica in the jelly-like state, is effected in the course of a few minutes by a solution containing one ten-thousandth part of any alkaline or earthy carbonate, but not by caustic ammonia or neutral or acid salts, nor by sulphuric, nitric, or acetic acid. Coagulation occurs in a short time after passing carbonic acid through the solution. We will make the experiment of producing the jelly by the addition of a little carbonate of soda to this solution. It is one of the prettiest experiments connected with the subject. I am sorry I cannot present it on a larger scale. This is a perfectly limpid liquid solution. Now, after adding a little of this solution of carbonate of soda to it, we shall soon have it, I think, so solid that we shall be able to invert the glass without spilling it. It always takes a little time; and when it is suddenly made, it is always, as I have said, opalescent, and not transparent like that which you have in the tube. Hydrochloric acid, on a small quantity of caustic potash or soda, gives stability to the solution. It has a slightly acid reaction, somewhat greater than that which may be produced by carbonic acid. Dried by the air-pump *in vacuo*, at the ordinary temperature, it forms a beautiful, transparent, glassy mass of great lustre, no longer soluble in water, and which reminds one greatly of that beautiful variety of opal termed "hyalite." Here it is. It is, in fact, opal. This is some prepared by Professor Graham in the way mentioned. The jelly has been dried by evaporation *in vacuo*. It may retain as much as 21 or 22 per cent. of water.

I am just selecting all those points which I think have an express bearing on geology. Ordinary silicate of soda is not at all what is termed "colloidal;" that is to say, if I were to put this silicate of soda into this hoop-vessel, and leave it there floating upon the water, it would pass through, to a certain extent, to the water, but there would be no separation of its constituents. When hydrochloric acid is added and the constituents eliminated, then it is that you get this action set up. This soluble form of silica unites with various organic matters, as, for example, with common gelatine, or with skin. In fact, you may tan by means of silica, and produce leather containing as much as 70 per cent. of silica.

We will now inquire, with regard to this peculiar solution of silica obtained by Professor Graham, whether there is any reason to suppose that a similar process to that by which this is prepared may play any part in the operations of nature. The condition required is, that there should be a soluble silicate, and there is no difficulty in explaining how this may be produced. This we shall examine hereafter, when we speak of the silicates. The condition is, a soluble silicate dissolved in water, and the decomposition of that silicate by some agent, such as hydrochloric acid. We thus get the solution, and now for the apparatus. Does nature present us with any apparatus which can take the place of this so-called dialyser? All that we want is the porous bed of some rock like sandstone, in some convenient position, and that sandstone will act exactly as the dialysing apparatus here acts. It remains now for practical geologists to look out for these conditions, and see how far an application can be made of these important discoveries of Professor Graham.

I now call your attention to the separation of the silica. Every bubble of the fluoride of silicon as it passes up through the water becomes immediately decomposed, and a portion of the gas escapes, not being thoroughly in contact with the water everywhere, and produces a slight smoke. We want to avoid the production of that smoke as far as possible. I think we may really have reason to believe that this solution may play an important part in the phenomena of nature; for I think, as we shall see hereafter, that there is no difficulty in explaining how such a solution may be obtained as is requisite to exhibit the phenomena of dialysis; and I think that, very probably in nature, we may find conditions exactly suitable for dialysis. Well, then, if this be the case, we shall be at no loss to understand how in many instances silicification has occurred. We know that it has occurred, and occurred to an enormous extent, in nature. The mineral termed "opal," which I have referred to several times, is nothing more than amorphous silica containing a little water. The proportion of water is not definite; it is variable, the extremes being somewhere about 3 per cent. and 13 per cent. of water. Sometimes this opal exhibits most beautiful colours, and then it acquires the name of "precious opal." These colours are due to a peculiar structural arrangement, and may be explained by the laws of optics. Now, here is a mass of opal from Mexico; and if any one will just examine these two in contact—the substance prepared by evaporation *in vacuo* by Professor Graham's experiment, and the natural opal—he cannot fail to be struck with the resemblance between the two. The mineral termed "hyalite" is also a kind of opal met with in basaltic rocks. It is another form of amorphous silica. This hyalite contains an amount of water, the extremes of which are 3 and 6 per cent. Here is another specimen of it.

I will now call your attention for a minute or two to a peculiar substance which has been found in our blast furnaces or iron-smelting furnaces; and I think we shall see reason in the course of these lectures to believe, that even these processes which are so abundantly practised, or rather, practised on so large a scale in various parts of this country, may really furnish indications of great importance to the geologist. In the hearths of blast furnaces is occasionally found a white, delicate, fibrous substance, to which the name of "fibrous silica" has been given. It has been carefully examined, especially by Rose, who finds it to consist essentially of silica. It is silica in the amorphous state—silica produced at a high temperature, and, therefore, having a specific gravity not exceeding 2·2 or 2·3. It has been found in many furnaces. We are not perfectly certain yet as to the precise conditions under which it has been generated, but most likely it may have resulted from the oxidation of silicon. Sorby informs us that he obtained fibrous silica, exactly similar to that occurring in the hearths of blast furnaces, by passing that gas which we are now passing through the water, fluoride of silicon, together with the vapour of water, through a porcelain tube heated to red-whiteness. By introducing the fluoride of silicon at one end of the tube, and the steam at the other, he obtained silica only in small vitreous grains. That is the amorphous silica.

Now, I cannot forbear, before concluding this lecture, just for a second forestalling what I shall say hereafter in speaking of the formation of certain igneous rocks, especially of granite. I will make one or two remarks by way of inference from the facts I have now laid before you. For a long time it has been the received notion, that all granite, which occurs so abundantly in the crust of the earth, has been the result of igneous fusion at a very high temperature; but there are certain difficulties which have always been in the way of accepting this view of the subject—difficulties known, at all events, to those who have been accustomed to make experiments on the fusion of mineral substances at high temperatures. Now, let us look at the fact of quartz occurring in this granite. Granite consists, as most of us know, of three minerals—quartz, mica, and felspar. Quartz is crystallised, and always has the specific gravity 2·6. There is not a single instance known to the contrary. There is, therefore, reason to believe that that quartz never could have been fused; for we have seen that the moment we fuse silica, no matter in what state it was previously, you obtain a glass-like colloidal or non-crystalline mass, having a specific gravity never exceeding 2·3. If this be so, then I think you will agree with me that there is something like a foundation for the inference, even from this single fact, that such granite could never have been produced under the condition of a high temperature. What those conditions under which it was produced may be we shall hereafter consider.

PARIS ACADEMY OF SCIENCES.

December 21, 1863.

THE only paper of interest read on this occasion was by M. Scheurer Kestner, "*On the Theory of Leblanc's Soda Process,*" which, containing a reply to the views of Messrs. Gossage and Kynaston put forth in our pages, we shall translate at length in an early number.

NOTICES OF BOOKS.

The Pharmacopœia of the United States of America. Fourth Decennial Revision. By Authority of the National Convention for revising the Pharmacopœia held at Washington A.D. 1860. Philadelphia: Lippincott and Co., 1863.

ON the eve of the publication of the British Pharmacopœia, it may be of some interest to notice what has been doing in the same way in other parts of the world.

The Pharmacopœia of the United States, like the British, has been compiled by a national committee. Delegates of the various medical associations, colleges, and universities met at Washington in May, 1860; and it is worthy of notice that we find among them seven representatives of three colleges of Pharmacy. The preface to the work is dated June, 1863; so we conclude that the convention finished its labour in three years.

The preceding Pharmacopœia has undergone extensive alterations, and the present work appears to us, after a rather hasty perusal, to be eminently practical. The use of all weights but the ounce and the grain has been discarded; "and, to guard against the error of substituting the avoirdupois ounce, the word is now always printed *troyounce.*" Our American brethren are, therefore, still left embarrassed with two ounces, and two pounds—an embarrassment which will, probably, disappear at the next decennial revision, if our own experiment should be found to answer well. The old wine gallon, and the pint of sixteen ounces, are still retained, but the gallon is never used in the Pharmacopœia.

Percolation is commonly employed for the exhaustion of materials, and careful directions are given for conducting the process. In connection with this, we find that the degree of comminution to which it is necessary to reduce different materials, is expressed by the words, *very fine powder*, *fine*, *moderately fine*, *moderately coarse* and *coarse*. The powder passed through a sieve of eighty or more meshes to the inch, is designated *very fine;* through one of sixty meshes, *fine;* through one of fifty meshes, *moderately fine*; through one of forty meshes, *moderately coarse;* and through one of twenty meshes, *coarse.*

The Materia Medica is arranged on just the same plan as is followed in our own Pharmacopœia. It includes most of the substances known here as the "New American Remedies," some of which we believe will be found in the British compilation; and other things, which, though in great repute, are seldom prescribed, at all events, in Latin, as for example, the following:—

> "SPIRITUS FRUMENTI.—*Whisky.*—Spirit obtained from fermented grain by distillation; and containing from 48 to 56 per cent. of absolute alcohol. Whisky for medicinal use, should be free from disagreeable odour, and not less than two years old;"—in fact just the article proper for convivial purposes.

In the list of preparations there is much that we should like to extract, for in most cases the processes are practical, and the results we should think would be excellent. The list is arranged alphabetically, and one of the first things we come upon is *Aconitia.* The directions given for the preparation of this alkaloid are similar to those which we believe will be given in the British Pharmacopœia. But by the American process the aconitia is obtained in the anhydrous state as a hard, brittle, resinous substance, which has to be scraped from the dish, and reduced to powder. Now, in the case of so active a substance as aconitine, this must be a dangerous operation—one we would rather decline to perform—and it would be much better to render it unnecessary by precipitating the alkaloid in a hydrated form from an acid solution.

The aromatic *aquæ* we find directed in most cases to be made with the essential oils, by means of magnesia, in the way well known to all English pharmaceutists.

A very useful class of preparations has been introduced under the name of *fluid extracts*. These are in many instances really concentrated tinctures; but in some cases, where the greater part of the spirit is lost by evaporation, sugar is added to preserve them, as, for example, in Extractum rhei fluidum, the directions for preparing which are as follows:—

"Take of rhubarb, in moderately fine powder, sixteen troyounces; sugar, in coarse powder, eight troyounces; alcohol, a pint; diluted alcohol, a sufficient quantity. Moisten the rhubarb with four fluidounces of the alcohol, introduce it into a conical percolator, stir it gently, and pour upon it the remainder of the alcohol. When the liquid has disappeared from the surface, gradually pour on diluted alcohol, until a pint of tincture has passed. Set this aside in a warm place until reduced by spontaneous evaporation to six fluidounces; and continue the percolation until two pints more of tincture have been obtained. Evaporate this by a gentle heat to six fluid ounces; then add the sugar, and, when this is dissolved, the reserved tincture, and continue the heat until the whole is reduced to the measure of a pint."

In some instances a small quantity of acetic acid is employed in these preparations, with advantage probably in the cases of ipecacuanha, ergot, and colchicum, but we do not see the object in the case of hemlock.

The chemistry of the Pharmacopœia, as illustrated in the preparations of iron and mercury, is, so far as we have seen, unexceptionable; but we remark that our American brethren in their nomenclature pass over differences of composition, and found their names on physiological and physical differences. Thus we have Hydrargyri chloridum corrosivum, and Hydrargyri chloridum mite, for the two chlorides of mercury; and Hydrargyri iodidum rubrum, and Hydrargyri iodidum viride, for the two iodides.

Among the Infusa we find nothing worthy of note, excepting that a small quantity of sulphuric acid is employed in cold infusions of bark prepared by percolation.

The Misturæ are mostly identical with those in our own Pharmacopœia; and many of the Pilulæ are well-known to us; but there is a form for Pilulæ ferri iodidi which we may quote, as some medical men have a fancy for prescribing iodide of iron in pills. It is as follows:—

"Take of iodine half a troyounce; iron, in the form of wire, and cut into pieces, one hundred and twenty grains; sugar, in fine powder, a troy ounce; marshmallow, in fine powder, half a troyounce; gum arabic, in fine powder, reduced iron, each sixty grains; water, ten fluid drachms.

"Mix the iodine with a fluidounce of the water in a thin glass bottle, add the iron, and shake them together until a clear, green solution is obtained. Mix the powders in a small porcelain capsule, and filter upon them, through a small filter, first the solution previously heated, and afterwards the remainder of the water to wash the filter. Then, by means of a water bath, with constant stirring, evaporate the whole to a pilular consistence, and divide the mass into 300 pills.

"Dissolve sixty-grains of balsam of tolu in a fluid drachm of ether, shake the pills with the solution until they are uniformly coated, and put them on a plate to dry, occasionally stirring them until the drying is completed. Lastly, keep the pills in a well-stoppered bottle."

If successfully prepared, we have no doubt these pills will be "unchangeable."

(To be continued.)

NOTICES OF PATENTS.

2277. *Improvements in Extracting the Sulphur and Sulphurous Acid from the Oxy-Sulphuret of Calcium which is contained in the Residues or Waste Material obtained in the Manufacture of Soda.* W. Schnell, Charlotte Street, Fitzroy Square, London. Dated August 13, 1862. (Not proceeded with.)

In carrying out this invention, the waste material is in the first instance freely exposed to the action of the air. For this purpose it is spread out in thin layers upon frames or hurdles placed one above another, at such intervals as will allow of unrestrained access of air, the material being kept constantly moist for a period varying between two and three weeks, but never longer than a month. At the end of this time it is removed and lixiviated with water at a temperature not exceeding forty degrees centigrade, whereby a solution of hyposulphite of lime is obtained, and that portion remaining insoluble is again collected and exposed to air as before, until no further quantity of the hyposulphite can be extracted. For the recovery of the sulphur and sulphurous acid from these solutions, they are to be decomposed by hydrochloric acid at a boiling temperature, when the sulphurous acid gas is given off, and the remaining sulphur deposited in an elementary form; this last product is, after washing, perfectly pure. If it be desired to obtain the sulphur only, the hyposulphite solutions are evaporated to dryness, and distilled in iron retorts, but by this process only half the total amount is obtained, since the residue in the retort contains much sulphite and sulphuret of calcium. If, on the other hand, it be desirable to economise the whole of the sulphur in the form of the gaseous product (sulphurous acid), this process of distillation should give place to one of roasting, whereby in a current of air the main portion of the sulphur is driven off in an oxidised form, whilst the lime, in admixture with a certain quantity of the sulphate of that base, remains behind in the furnace.

The advantage of this mode of proceeding stands in unfavourable comparison with that by which the hyposulphite liquors are made to furnish the crystallised soda salt as the marketable product.

2295. *Manufacture of Colouring Matters.* John S. Blockey, Leeds. Dated August 14, 1862. (Not proceeded with.)

The inventor prepares red, blue, and purple colouring matters by acting upon aniline, or its homologues, with a mixture of nitric and hydrochloric acids, employed at the temperature of about 180° F. The several coloured products are formed simultaneously; they may afterwards be separated by known processes. The production of one or other of these dyes may be, however, to some extent, controlled, either by modifying the proportions of the two acids employed, or by taking more or less aniline or other homologous base.

2294. *Decolorising Solutions of Sugar, &c.* William Bird Herapath, Bristol. Dated August 14, 1862. (Not proceeded with.)

The inventor adds to the saccharine juice or solution of sugar a small quantity of the hypochlorite of an alkali or alkaline earth, using by preference the common bleaching powder, or hypochlorite of lime, dissolved in a small proportion of water. The lime thus added is afterwards separated by precipitation with the phosphate of soda or potash, and the insoluble phosphate of lime removed by filtration.

It is probable that this last-named compound would, like alumina, directly serve in the removal of colouring matters and suspended impurities from the raw juice or sugar.

2296. *Treating Crystallisable Sugar, to render it more suitable for Fermentation and Conversion into Alcohol and Vinegar.* William Bird Herapath, Bristol. Dated August 14, 1862.

In the treatment of highly-coloured samples of cane or beet sugar, it is recommended to bleach with hypochlorite of lime before proceeding to operate upon it by the mode which forms the subject of this patent. The sugar is dissolved in hot water (about 180° F.), with which a small proportion of moderately pure hydrochloric acid has previously been mixed; or the acid may be added subsequently to the solution of the sugar in water. The temperature is now raised to boiling, and maintained at that heat for two or three hours, after which the free acid is neutralised by the addition either of carbonate of potash or soda, lime water, milk of lime, chalk, or other suitable material, taking the precaution not to use any of these in excess. At this stage the saccharine solution will be found to undergo the alcoholic fermentation with unusual facility; it merely requires to be cooled and diluted to the point at which brewers are in the habit of starting the fermentation of beer-wort, and may be turned into vinegar by following the usual processes.

The action of hydrochloric acid at a boiling temperature would induce the conversion of cane into grape-sugar, which is known to undergo fermentation more readily than the original or crystallisable sugar.

CORRESPONDENCE.

Gas Combustion Furnace.

To the Editor of the Chemical News.

Sir,—In your report of the proceedings of the Chemical Society, inserted in this day's Chemical News, you attribute the description of a gas burner for organic analysis to "Dr. Herapath, of Bristol." As it came from me, I shall feel obliged by your correcting the mistake in your next number. I am, &c.

William Herapath, Sen.,
Professor of Chemistry.

Old-park, Bristol, Dec. 26, 1863.

The Patent Laws.

To the Editor of the Chemical News.

Sir,—In your last number you give a contribution to the fun of the season, and I am not sure but there is something similar on the same page, contributed by Mr. Williams. He compares capitalists, whose operations are hampered by the patent laws, to those who take other people's "pocket-handkerchiefs, watches, plate, purses, &c., burglars, pickpockets, and area sneaks." This may be good fun, but is it good sense? Is there any relation between the fancies of a schemer's brain and a man's purse? Seriously, this patent law is a gigantic incubus on everything like work. In proof of what I say, let me give you a sample of its working. I have a tract of land which I believed to contain valuable minerals, and some time ago, I, acting under the advice of a mining engineer, proposed to explore my land by boring. I learned this could be done in two ways—one by the power of men, which is slow, the other by the power of steam, which is the quick way. Of course, I chose the quick way, but here the patent law stopped me. I found the steam-boring apparatus was patented, and I must buy it from the patentee or his licensees, paying them enormous profit, or be content with the old way. Surely this is a great grievance, but that is little to what followed. When I had gone through all the trouble and all the expense of exploring, sinking pits, and bringing the minerals to the surface, I found I could not use them to the best advantage. A patentee steps in, and says, "You shall not use my process without paying me." Now, surely there never was such an absurd law as this. Was there ever anything so un-English as a law to prevent a man doing what he likes with his own? I could multiply examples, but I think I have said enough to show the senselessness and injustice of the patent law. I am, &c.

Anti-Schemer.

MISCELLANEOUS.

Royal Institution.—Tuesday, January 5, 3 o'clock, Professor Tyndall, "On Electricity at Rest and Electricity in Motion."—Juvenile Lectures. Thursday, January 7, 3 o'clock, Professor Tyndall, "On Electricity at Rest and Electricity in Motion."—Juvenile Lectures.

Pharmaceutical Society.—The next Pharmaceutical meeting will take place on Wednesday evening, the 6th of January, at Eight o'clock. The chair will be taken at half-past Eight precisely. The following papers will be read:—"Note on the Root-Bark of Calisaya." By John Eliot Howard, F.L.S. "Note on *Cassia moschata*." By Daniel Hanbury, F.L.S. "On Goa Powder." By Mr. David S. Kemp. "Note on the Recovery of Essential Oils from their Watery Solution." By Mr. T. B. Groves. Thompson's Patent Bottles, and Thonger's Patent Label for the Prevention of Accidental Poisoning, will be exhibited at the meeting.

Alkali Works.—On the 1st inst., the Act passed in the late session for the more effectual condensation of muriatic acid in alkali works, will take effect. The object of the statute is to secure the condensation of the gas to the satisfaction of the inspector or sub-inspector appointed under the Act. If it should appear to the court before whom any proceeding for the recovery of a penalty is instituted, that 95 per cent. at least of the muriatic acid gas evolved has not been condensed, a penalty not exceeding 50*l.* will be levied, and for a second offence 10*cl.* The owner is to be liable for the offence in the first instance, unless he prove that the offence was committed by some agent without his knowledge, in which case the agent, &c., is to be liable. We have not yet seen the inspectors and sub-inspectors gazetted.

Talmi Gold.—A beautiful gold-coloured alloy, sold under the above name, gave, on analysis, the following results:—

Copper	86·4
Zinc	12·2
Tin	1·1
Iron	0·3

The iron was probably an accidental ingredient. The alloy besides was very thinly gilt. It is a good deal used to make watch-chains.—*Centralblatt*, No. 52, 1863.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

F. Ruschhaupt (Berlin), shall receive a private communication.

M. P. S.—The suggestion shall be attended to.

Assistant.—A solution of borax is used.

A Subscriber.—We know of no work specially devoted to the chemistry of explosive compounds.

E. Fontanella.—There is a practical work on oil refining, we believe, among the series published by Roret, Paris.

Books Received.—Culley's "Handbook of Practical Telegraphy;" "Spectropia;" "The Dircksian Phantasmagoria;" Braithwaite's "Retrospect;" Hardwich's "Photographic Chemistry," new edition.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Volumetric Estimation of Manganese, Antimony, and Uranium; and on some Compounds of these Metals, by M. Antony Guyard.*

(Concluded from page 293, Vol. VIII.)

Estimation of Antimony.—The method I propose is rapid and exact; it depends upon the following facts:—

1. Whatever may be the compound of antimony to be assayed, it must be separated from all the bodies which usually accompany it, and converted into sesquichloride of antimony; if dissolved in sulphide of ammonium, the solution is supersaturated with hydrochloric acid and boiled.

2. In a dilute and very acid liquor, permanganate of potash instantly transforms the sesquioxide of antimony into antimonic acid, the reaction being exactly represented by the following equation:—

$$5Sb_2O_3 + 2KO,Mn_2O_7 + 6HCl = 5Sb_2O_5 + 4MnCl + 2KCl + 6HO.$$

3. During the peroxidation of the antimony, the solution of permanganate of potash is decolorised; but as soon as the reaction is complete, a drop of the permanganate communicates the usual roseate tint.

Operation.—The compound to be analysed is to be dissolved by appropriate reagents; that done, the solution is supersaturated first with ammonia, and then with yellow sulphide of ammonium. When all the antimony is dissolved, the solution is filtered, and an excess of hydrochloric acid is added to the filtrate. The sulphide of antimony is precipitated with sulphur. It is left in a warm place for the precipitate to settle, and the greater part of the liquor is decanted. A large excess of hydrochloric acid is then added to the mixture, and the whole is boiled until all the sulphuretted hydrogen is got rid of. The solution is then filtered, to remove the sulphur, and the filtrate is diluted with about a litre of water. Sufficient hydrochloric acid to make the solution perfectly limpid is then added. The quantity of acid besides must be sufficient to keep the oxide of manganese from the permanganate in solution, and also the antimonic acid, which is less soluble in diluted hydrochloric acid than the sesquioxide of antimony. A solution so prepared is ready for the permanganate of potash, which must be added with the usual precautions, until the rose colour is obtained.

The solution of permanganate should be of such a strength that 30 or 35 cubic centimetres will represent one gramme of antimony. To titrate the solution I use either a sulphide—the exact composition of which I know—or tartar emetic, dried at 100° C. The latter salt is very convenient for the determination, because of its unalterability, and the ease with which it can be prepared quite pure. Although this salt is very soluble in water, and remains quite clear, it is necessary to add hydrochloric acid before the permanganate, because, under such circumstances, the tartaric acid does not act on the permanganate for a considerable time, and, consequently, does not interfere to prevent the desired result.

The above process is capable of very general application. It may be applied with equal certainty to the analysis of antimony of commerce; to the alloys which the metal forms with arsenic and all other metals (tin excepted); to the oxides of all degrees; to all the salts, organic and inorganic; to the natural sulphides; and to the multiple sulphides which antimony forms with iron, nickel, copper, lead, and silver; and, finally, to the direct determination of antimony in the sesquisulphide, which is never obtained perfectly pure in the analysis of antimony by the ordinary method.

Lastly, I have been fortunate enough to rectify, by this process, an analysis of sulphide of antimony from Borneo, very like the ordinary sulphide, but which the analysis showed to have the following composition:—

Antimony	76·10
Sulphur	23·60
Gangue	0·30
	100·00

a composition which corresponds to the formula—Sb_4S_5.

Estimation of Uranium.—The estimation of uranium by weight presents no difficulty; having occasion, however, to analyse a great number of uranium minerals, I felt the want of a rapid and certain method, and, after numerous attempts, I adopted the following process, which perfectly answers the purpose:—

1. The uranium is separated from all the bodies which ordinarily accompany it, and which will interfere with the estimation, by following the process which I shall give presently.

2. The acid phosphate of sesquioxide of manganese forms, in acid solutions of acetate of sesquioxide of uranium and ammonia, an insoluble triple phosphate of ammonia, uranium, and manganese of constant composition.

3. The precipitate appears white, with a yellowish shade, as long as the precipitation lasts, but when this is complete the precipitate has a rose colour, with a dash of bright yellow.

Operation.—A gramme or a gramme and a-half of the salt or ore to be assayed is dissolved in nitric or hydrochloric acid, or *aqua regia*. The solution is then supersaturated with carbonate of ammonia, which separates sesquioxide of uranium from metallic oxides, earthy, and alkaline-earthy, which so often accompany it. In many cases this operation suffices; but if the ore contains phosphorus, or arsenic, or an oxide soluble in carbonate of ammonia, the uranium must be precipitated by ammonia and sulphide of ammonium in the state of protoxide, and filtered. The residue of protoxide of uranium is dissolved in carbonate of ammonia, and then transformed into the acetate of sesquioxide. In any case the uranium is brought into this latter form. That done, the solution is diluted with about a litre of cold water, and then the standard solution of phosphate of manganese is gradually added from a burette, until the whitish precipitate of phosphate of uranium, manganese, and ammonia, appears rose coloured.

Preparation and Titration of the Normal Solution of Phosphate of Manganese.—To prepare this solution, phosphorus is acted on by nitric acid, and, when the phosphorus is dissolved, the solution is evaporated, in a platinum capsule, to a syrupy consistence. Sesquioxide of manganese, in fine powder, or any oxide of manganese, is then added by degrees, stirring frequently. The mixture is then heated for some time, and when the fused mass assumes a blue tint, and the phosphoric acid begins to volatilise, it is allowed to cool. It then becomes purple, and, if dissolved in water, it forms a purple solution very like the solution of hypermanganate of potash. This solution is diluted so that thirty cubic centimetres shall represent one gramme of metal. To titrate this solution, we use the oxide of uranium U_3O_4 very pure, or the protoxide. To prepare the latter easily in a state of purity, it is only necessary to fuse an oxide, or any pure salt of uranium, with four or five times its weight of a mixture of equal parts of cyanide of potassium and carbonate of potash. The fused mass is first washed with a solution of sal-ammoniac, and then with pure water. The residue dried out of contact with the air is the pure oxide of uranium UO, unchangeable in the air if prepared at a sufficiently high temperature.

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* Communicated by the Author.

Remarks.—1. The tinctorial power of the phosphate of manganese is very weak; a drop of even a concentrated solution will not give a rose colour to much water. In the determination of uranium by means of this liquid, a curious circumstance happens. The triple phosphate of ammonia, uranium, and manganese which is precipitated is really formed of white phosphate of uranium and ammonia, and rose-coloured subphosphate of manganese. As long as there is uranium in solution, the rose colour of the subphosphate of manganese is completely hidden; but as soon as all the uranium is precipitated, the rose colour appears.

2. The solution of phosphate of manganese is really only a solution of subphosphate of manganese in an excess of phosphoric acid.

On the Suboxides of Uranium.

In attempting to reduce the salts of uranium by means of zinc, in order to reduce them to the state of protoxide UO, and then to determine the uranium by means of permanganate of potash, I found that I did not obtain exact results; and that, according to the quantity of pure zinc used in the reduction of the salts, the *titre* of the solution advanced, and that it was necessary to use much more of the solution, as the amount of zinc was increased. In fact, the zinc at first reduced the salts of peroxide of uranium to salts of protoxide; but, if the reduction is continued, a suboxide U_2O is found, which, in its turn, is reduced by the action of zinc and hydrochloric acid to another suboxide, U_3O_2.

Properties.—The suboxide U_2O gives, like the protoxide UO, a bright green solution; but, while ammonia precipitates the protoxide in the form of a violet-coloured hydrate, it precipitates the suboxide U_2O as a bright green hydrate. Further, when the protoxide is completely transformed into the suboxide U_2O, the first effect, with an excess of zinc, is to precipitate the latter oxide in the form of a bright green powder, which is deposited upon the zinc, and redissolves in acids with its peculiar colour.

When the suboxide U_2O is reduced with an excess of zinc, and care is taken to have enough acid to keep it in solution, the bright green liquor soon becomes of a very deep hyacinth red. Ammonia determines, in this solution, a bright green precipitate, consisting of the suboxide U_3O_2, differing from the former by the hyacinth red colour of its solutions. These suboxides are very unstable, and if kept in the air, whether in solution or not, they rapidly pass into a higher state of oxidation.

To analyse these oxides, I reduced, with great care, a known weight of protoxide of uranium, and peroxidised them by means of a standard solution of permanganate of potash, prepared for the purpose, and containing a known weight of the pure and crystallised salt. The amount of solution required was found to be in an inverse ratio to the amount of oxygen combined with the uranium, and in this way, after some inevitable disappointments, I found that it was possible to arrive at sufficiently exact results.

Uranic Acid.

The nitrate of the sesquioxide of uranium does not combine with nitrate of silver when a mixture of these two salts is precipitated by potash. We only obtain a dirty grey mixture of the two oxides.

But, on the contrary, if we introduce recently precipitated oxide of silver into a solution of nitrate or any other salt of uranium, and heat the mixture a little, a part of the oxide of silver is substituted for the oxide of uranium; and this latter, in depositing, combines with excess of oxide of silver, forming with it an amorphous compound of a magnificent orange-red colour. The formula of this compound is $AgO,2(U_2O_3)$, and it may be called the *uranite of silver;* in composition it exactly resembles the alkaline uranites.

If, however, we invert the order of the experiment—that is to say, if we precipitate the oxide of the nitrate of silver by means of sesquioxide of uranium or an alkaline uranite, and heat the mixture, a brilliant black crystalline powder is soon formed, the formula of which is $AgO,2(U_2O_5)$—that is to say, *uranate of silver.*

The following equation will represent the formation:—

$$2(AgO,NO_5)+KO,2(U_2O_3)=AgO,2(U_2O_5)+KONO_5 \\ +AgONO_3.$$

This salt is sufficiently stable to analyse, but I was unable to isolate the uranic acid it contained.

The latter facts confirm the relations between uranium and antimony established by a celebrated chemist; but the theory he has published on this subject does not seem to me sufficient, and I hope soon to substitute another, for which I shall gather together the facts, and extend my experiments.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, *F.C.S.*

(Continued from page 249)

4. **Invention of the Air-pump.**—About ten years after the discovery of the pressure of the air, Otto Von Gucricke,[*] a burgomaster of Magdeburgh, made a number of experiments, with a view of obtaining a larger vacuous space than that which could be procured by Torricelli's method; for, although the behaviour of certain bodies in a vacuum had been tried by introducing them into the Torricellian vacuum, this mode of experimenting was obviously attended with numerous difficulties, and but few substances could be placed in a vacuum obtained by such a process.

Gucricke conceived that he could effect his object by completely filling a vessel with some substance which could be removed without allowing air to take its place. He, accordingly, filled a wooden cask with water, and fitted into it a syringe, all other parts being closed as securely as possible; he then pumped out the water, expecting that a vacuum would be produced in the cask, but air readily entered, by the crevices, to occupy the space which the water left.[†]

Having previously observed, however, that air could be made to expand to any extent, he determined to cause air to leave a vessel, in virtue of that property, and to prevent its return by external means. In order to effect this, he took a copper globe, and fitted into it a syringe; when the pumping was commenced, the piston worked somewhat easily, but became more and more difficult to raise, and in a few minutes the globe was compressed with a loud noise.

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[*] Born, 1602. Died, 1686.

[†] See "Ottonis de Guericke Experimenta Nova (ut Vocantur) Magdeburgica de Vacuo Spatio." Amstelodami. 1672.

Guericke next procured a glass globe, furnished with a straight brass tube, containing a stop-cock, by means of which free communication with the interior of the globe could be established or prevented; to the lower part of the tube, and inclined to it at an angle of 45°, a syringe, having a solid piston, was adapted. Near the lower end of the syringe, a lateral valve opening outwards was placed, and at the juncture of the syringe with the tube there was a second valve, opening into the syringe. The valve and stop-cock were immersed in water to prevent air from leaking into the apparatus.[‡] It is obvious that, on raising the piston of such an air-pump, the air in the globe will expand, open the lower valve, and escape into the body of the syringe, while the lateral valve will be kept closed by the pressure of the air; and, on depressing the piston, the lower valve will close, and the lateral valve will open to allow the air in the body of the syringe to escape. A good vacuum could be obtained by this instrument, but it required a great deal of pumping to produce it.

Soon after the invention of the air-pump, Guericke constructed the "Magdeburgh hemispheres," a full account of which, Schottus informs us, was first given to him in July, 1656. In Guericke's "Experimenta Nova" there is a picture which conveys to the mind a good idea of the enormous pressure of the air. In the centre of this picture we observe a pair of large Magdeburgh hemispheres, to each of which eight horses are attached, and, although most evidently urged to their uttermost by men, who flourish aloft gigantic whips, they are unable to effect the division of the sphere.

Among other experiments made by Guericke with his air-pump, we may mention the following:—

1. A sparrow placed in the receiver died on exhausting.
2. A candle was extinguished in an exhausted receiver, because, says Guericke, *fire consumes air*.
3. Water was found to rise to a great height in an exhausted tube, and when the exhausted receiver of the pump was opened under water, water violently entered, and almost filled it.
4. A vessel exhausted of air was found to be considerably lighter than before exhaustion.
5. A bell made to ring in an exhausted receiver was inaudible until air had been admitted.

Kircher[§] had previously tried this experiment in the Torricellian vacuum by ringing a bell, the clapper of which was of iron, and was moved by the alternate approximation and withdrawal of a magnet. Kircher states that the sound was distinctly audible, from which we may infer that he suspended his bell within the tube by means of some substance capable of transmitting the vibrations to the tube.

Guericke did not believe the air to be elemental, and considered it incapable of being converted into water.

The following is his definition of air:—

"Aer est nihil aliud quam expiratio aut effluvium, aquarum, terrarumque, et aliarum rerum corporearum."

The science of Pneumatics, which took its rise immediately after the invention of the air-pump, was greatly extended in England by some of that band of experimental philosophers which arose shortly after the death of Bacon. Foremost in that band, if not the very leader of it, was Robert Boyle,[‖] a man who, despising all previous philosophies, applied himself vigorously to carry out the ideas of Lord Bacon. Boyle had the greatest reverence for the "Novum Organum," and there could not be a mind better adapted than his for putting in practice the "new philosophy." He was the very man that was wanted, at a time when speculative philosophy, unaided by experiment, was being changed for experimental philosophy, aided by inductive reasoning.

"But our hope of further progress in the sciences," writes Bacon, in the "Novum Organum,"[¶] "will then only be well founded when numerous experiments shall be received and collected into natural history, which, though of no use in themselves, assist materially in the discovery of causes and axioms, which experiments we have termed enlightening, to distinguish them from those which are profitable. They possess this wonderful property and nature, that they never deceive or fail you; for being used to discover the natural cause of some object, whatever be the result, they equally satisfy your aim by deciding the question."

Now, Boyle was the man to thus promote the welfare of the sciences; he was not one to cultivate them for profit to himself, or for renown, but he chose rather to study science for the pure love of the thing; and such men only have a right to bear the title of Philosopher, and by them alone is science permanently benefited. Bacon was the architect who planned out a glorious structure, and Boyle was one of the master-builders of his day; and he laid the foundation of a part of that building so securely, that it still endures; and although now and then we have to remove a brick which has fallen to decay, we still continue to build on that foundation, and the workmen increase, and the building rises rapidly,—let us hope it may be soon roofed in.

The writings of Boyle extend over a period of thirty years; they are excessively prolix, but with so few previous experiments on most of the subjects, it was difficult to avoid describing the most trivial effects: we must remember, moreover, that he wrote of phenomena hitherto almost unknown to the human mind, and we must overlook the tediousness of the accounts of his experiments, which, although they appear very detail to us, were probably not too much so for his contemporaries.

Boyle's first work on the air appeared in 1661, and was entitled "New Experiments, Physico-Mechanical, Touching the Spring of the Air and its Effects; made for the most part in a new Pneumatical Engine." The entire work is written in the form of a letter to Lord Dungarvan, and is dated December 20, 1659.

So soon as Boyle heard of the invention of Otto Von Guericke's air-pump, he determined to construct one which should be less cumbrous, and should not require to be placed in a vessel of water. He mentioned his wish to his friends, Hooke and Greatorex, and, after several unsuccessful trials, Hooke made for him an air-pump which was considered to be superior to Guericke's. It consisted of a hollow, vertical cylinder of cast brass, fourteen inches long and three inches internal diameter, the lower end of which was open, and the upper closed, with the exception of a small orifice in the line of the axis of the cylinder, and a tapering, lateral orifice, into which a brass stopper, serving as a valve, fitted airtight. A solid piston, to which vertical motion was given by means of a rack and pinion, worked within the cylinder. The receiver[**] was a glass globe capable of containing thirty wine quarts, fitted with a stopcock, the shank of which was cemented into the upper orifice of the cylinder; and in that part of the globe opposite the stopcock there was a circular-lipped opening four inches in diameter, to which a brass ring (diminishing the diameter of the opening to three inches) was cemented; the ring was closed by an "exquisitely-ground" brass plate, containing a half-inch circular orifice closed by a brass stopper, which could be turned, when the receiver was exhausted, without admitting air. The whole apparatus was arranged vertically, so that it was terminated above by the opening of the receiver for the introduction of bodies to be experimented upon, and below by the open orifice of the brass cylinder.

[‡] See "Mechanica Hydraulico Pneumatica," by Gaspar Schottus. 1658. Also, "Technica Curiosa" (1664), by the same Author.

[§] Born, 1601. Died, 1680.

[‖] Born, 1626. Died, 1691.

[¶] Book 1, Aph. 99.

[**] No one can have failed to observe how singularly inapplicable the name of "*receiver*" is to that part of an air-pump which it is desired to *empty* as completely as possible; the name was given by Boyle, who, in speaking of the vessel to be exhausted, says, "which we, with the glass-men, shall often call a receiver, for its affinity to the large vessels of that name, used by chemists."

Before commencing to exhaust the receiver, the piston and all the joints were well oiled, the piston pushed to the top of the cylinder, and the stopcock and lateral valve closed; the piston was then drawn to the bottom of the cylinder, and the stopcock opened to allow air to rush from the receiver into the vacuous space; the stopcock was now closed, the valve opened to allow of the exit of the air in the body of the cylinder, and the piston again forced to the top of the cylinder; the same process was repeated until the receiver was exhausted.

I do not consider this first air-pump of Boyle's by any means so ingenious a contrivance as that of Otto Von Guericke. The arrangement of the apparatus was indeed different, but the method of exhaustion was the same, more clumsily effected; the stopcock of Boyle's pump played the same part as the lower valve of Guericke's, and the lateral valve of the former the same as the lateral valve of the latter, with this disadvantage, however, that the valves of Boyle's pump had to be worked by hand, while those of Guericke's were worked by the air.

(To be continued.)

TECHNICAL CHEMISTRY.

Observations on the Sombrero Guano,

y ALEXIS A. JULIEN, *Resident Chemist at Sombrero.*

In anticipation of a paper on the subject of the guano island of Sombrero, which I hope soon to present, it is proper for me, from my peculiar advantages, to point out some of the errors into which Dr. Phipson* has fallen in his proposal to distinguish the Sombrero guano as a new mineral species.

He commences by saying: "This mineral forms a large portion of some small islands in the West Indies, especially of Sombrero Island." The only other islands in the West Indies, besides Sombrero, on which the rock guano has been found to occur, are Les Monges, El Roque, &c., off the coast of Guiana and Venezuela. The composition of the rock guano, however, from these islands is very variable, and, as the published analyses show, differs materially (except in general character) from that of the Sombrero guano, and altogether from the representative analysis for "Sombrerite" which Dr. Phipson offers further on.

In the course of the brief and very imperfect description of the physical characters of the Sombrero guano given by Dr. Phipson, he says: "It shows no signs of crystallisation whatever, but appears like an amorphous gelatinous phosphate that has been submitted to a high temperature." I have recently, however, discovered in certain localities small but perfect crystals of bone phosphate of lime (together with a small proportion of carbonate of lime and phosphate of magnesia), in the examination of which I am now engaged. Again, there is a natural division of the Sombrero guano into two varieties. One of an oolitic structure, of a great variety of colours, and containing, in addition to the bone ($3CaO, PO_5$) and neutral ($2CaO, HO, PO_5$) phosphates of lime, the phosphates of alumina, iron, and magnesia, organic matter, silica, &c. The other variety, generally of a broad concretionary structure, is of a white or yellowish-white colour, containing a little carbonate of lime, sulphate of lime, &c., but especially abounds in bone phosphate of lime. From these and other evidences, it is almost certain that the former more nearly resembles the original deposit and is the older of the two; while the latter is far more uniform in composition. These varieties are so characteristic that it would be difficult to find a block of this guano of a cubic foot in dimensions in which one or both of them would not be perceptible. The term "amorphous" can only be applied to those comparatively rare varieties in which these characteristics are mixed, or entirely indistinguishable on account of the uniformity in colour of the oolitic grains and their cement. Again, as the guano is interlaminated with ordinary coral limestone, and I have found all the phemonena it presents to be plainly attributable to atmospheric agents, there is no call for the conjecture of a "high temperature," nor for the following strange theory proposed in the latter part of the article:—"I look upon this rock as having found its way to the surface at a high temperature, in contact with water or steam, and under great pressure."

The "several kinds of shells," which Dr. Phipson then mentions among the fossils enclosed in the guano, belong entirely to the coral limestone which is very generally converted into phosphate of lime, wherever it is in contact with the masses of guano, or has been exposed in the veins to percolating guano solutions. The only synchronous fossils of the guano, yet discovered, are a variety of bones, the shells of a crab, rootlets, and a small coral.

As a representative analysis of "Sombrerite," Dr. Phipson offers that of "a well-chosen specimen"—the absurdity of which expression will be understood from what has been already stated. The Sombrero guano is as variable in composition, particularly in its content of earthy phosphates, as any other phosphatic guano, and as little entitled to rank as a new species. Dr. Phipson cannot possibly have examined with any care a single cargo—I venture to say, not even a single ton; for there is no natural standard by which a representative specimen could be "well-chosen" or chosen at all.

Further, Dr. Phipson does not inform us of the methods used by him in his analysis. This omission is unfortunate when we take into account the prevailing uncertainty among chemists as to the most exact mode of estimating phosphoric acid, in the presence of lime, iron, and alumina, also on account of some other curious results arrived at. Firstly, as to the 9 per cent. of water: it is to be presumed that the "well-chosen specimen" was carefully dried to remove moisture, which varies several per cent. in different varieties. It is also to be presumed, from the analysis, that "Sombrerite" contains no neutral phosphate of lime, with which a part of this 9 per cent. of water may be combined,† and that the two equivalents of water, combined in the

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* *Vide* Chemical News, vol. vi., p. 48.

† Notwithstanding that the presence of phosphoric acid in the filtrate, after long washing with hot water, has proved the existence of this salt in at least some common varieties.

"sulphate of lime," have been deducted from the gross amount. The variety of this guano which I have described as of concretionary structure especially predominates throughout the southern part of Sombrero Island, and over one-half our cargoes are composed of it. It contains on an average 83 to 85 per cent. of bone phosphate of lime—less than one per cent. of phosphate of alumina, and often none. We may very properly ask if this fact is to be entirely ignored in the consideration of the composition of "Sombrerite?"

The article concludes with the following objection to the use of this guano in the manufacture of superphosphate of lime:—"In producing the latter, Sombrerite gives rise to a certain quantity of sulphate of alumina, and this salt, being deliquescent, attracts and retains so much moisture that the product can be dried only with great difficulty"—an objection applicable with the same force to the 1·44 per cent. of similarly deliquescent chlorid of sodium. But every practical Chemist is aware that in this manufacture only a portion of the phosphate of lime of the material is ever intentionally and actually converted into superphosphate. It cannot be that Dr. Phipson supposes that this "sulphate of alumina" can be formed and exist in the presence of an excess of bone phosphate of lime. Finally, he has but to consult that same "manufacturer of superphosphate of lime" to learn how utterly groundless is his objection in fact as well as in theory.

Such of these observations as depend merely upon my own statement I shall hereafter more fully elucidate. We may safely conclude that a material so heterogeneous as the Sombrero guano does not possess the uniformity of composition requisite for distinction as a mineral species.—*American Journal of Science*, xxxvi., 424.

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.

Lecture II.—*Saturday, December 12, 1863.*

Ladies and Gentlemen,—In the lecture which I had the honour of delivering to you the day before yesterday, we considered the subject of silicon, one of the chief components of the solid crust of the earth. This silicon has only of late been carefully studied. It is certainly one of the most remarkable and important elements which we possess. It occurs, you will remember, in three distinct forms; and if you will allow me, although at the sacrifice of a little time, I will write them down, in order to make the matter perfectly clear. First, we have the pulverulent state, or amorphous condition of silicon, which is extremely divided, and perfectly non-crystalline. It is in the form of a chocolate brown powder, and it is, indeed, only recently that we have seen silicon in the crystallised state. We have it next in what is termed the graphitoidal state, or state resembling graphite. It occurs in the production of aluminium, or, at all events, it was first discovered in the making of aluminium by a particular process. It appears in the form of six-sided prisms, having a more or less metallic lustre, and a dark bluish-black colour. Then we have what is termed the octahedral form of silicon. In many characteristics it is very similar to the graphitoidal. In colour, for example, you can hardly distinguish the two. It crystallises in the regular cubical system to which the regular octahedral belongs.

Now, it is a curious thing that there is a remarkable analogy between silicon and carbon. Every chemist knows that there are very small chemical relations existing between the two, but with regard to the particular states in which the elements occur we find an analogy obtaining. Thus, we have common charcoal, which is the amorphous or non-crystalline form of carbon. We have the amorphous or non-crystalline form of silicon. We have the graphitic form of carbon exactly corresponding to the so-called graphitoidal form of silicon. Lastly, we have the diamond, which is the crystalline form of carbon, and corresponds exactly to the octahedral form of silicon. In fact, silicon in this state has been called the silicon diamond.

It is not my business on the present occasion to describe how this silicon can be obtained. That belongs rather to a purely chemical investigation. There is a compound well known to chemists, called silico-fluoride of potassium or sodium. You saw the gas which I generated here on the last occasion,—the transparent, colourless gas, consisting of the two elements, fluorine and silicon. Well, those two elements combine with potassium or sodium, forming a definite white salt—silico-fluoride of potassium or sodium. If we bring in contact with that salt some sodium or potassium, and also add a little common zinc, and heat the mixture, silicon is separated—displaced from its combination with fluorine by the sodium, and is immediately caught by the metallic zinc. We have here a specimen of sodium. It exists in our common salt, and is a beautiful, bright, shining metal. The temperature should be such as to keep the zinc in a molten state. The silicon so separated dissolves in this molten zinc, and, on solidification, it separates more or less completely from the metallic mass in a definite, beautiful, distinct crystalline form, the silicon being dissolved through the mass of zinc. All we have, then, to do is, to operate upon that zinc by means of common spirits of salts,—common hydrochloric acid, which dissolves the zinc, and leaves the silicon unacted upon. In this way these crystals before you were obtained. Notwithstanding the powerful affinity of silicon for oxygen, and the great exercise of force which it requires to separate the oxygen from the silicon in the state in which they are combined in silica, yet, when the silicon is separated, it is astonishing how remarkably stable it is. There it is. It may be exposed to the air for an indefinite time without undergoing the least change. You may heat it, indeed, to a very high temperature, even with access of air, yet it shall not be oxidised. You may expose it to the action of various strong chemical reagents, and yet it shall undergo no change. Well, now, it strikes us as extremely remarkable that a body which possesses such a strong affinity for oxygen, and requires the exercise of so much force to separate it from oxygen, should be so stable when separated as we find it to be. Exposed to a high temperature it fuses. Here is a specimen of this fused silicon, for which I am indebted, as I said in the last lecture, to Mr. Matthey, of Hatton Garden. We have it again here in a small quantity, but nothing to the extent which you see in the other specimen. This silicon is now playing a very important part in certain metallurgical operations. I just mention this incidentally. For instance, in the smelting of iron we find pig iron produced in various furnaces containing a considerable portion of silicon. I have known sometimes even as much as 8 per cent., and there is frequently 3 or 4 per cent. The presence of it in iron modifies the properties of the latter considerably. It combines readily enough with copper. If we take a little copper or iron in a more or less divided state, say in the form of filings, and mix these filings with common sand, which, as you know, is a compound of silicon and oxygen, and add an excess of charcoal, making a mixture of the three, and let the amount of charcoal and sand be such that, when we expose the mixture in a crucible to a high temperature sufficient to melt the copper or the iron, as the case may be, there should be sufficient of this mixture to retain the metal diffused through the mass, and then expose the mixture to a high temperature for a few hours—

all the silica, under the conjoined influence of the carbon and the metal, is decomposed, the carbon laying hold of the oxygen, and escaping in the form of carbonic oxide, and the silicon is set free, combining with the metal. Well, here is a piece of common copper which was treated in this way—heated with sand and charcoal for a long time. The metal has undergone a great change in its external appearance. It has no longer the red colour of copper, but has the appearance of bronze, which is a mixture of copper and tin. It is so like the bronze of which our guns are composed, that an inexperienced eye would not distinguish the one from the other when they are side by side. It is a very valuable alloy, so that you see that silicon may play a very important part even in the common arts of this country. I might give you another illustration of the fusion of silica. Platinum is a metal which requires a very high heat for its fusion. Now, if we heat silicon in contact with platinum at a high temperature, no change will take place. Here is an illustration of this fact. The platinum has undergone no change of form even in its thin edges; but let us add a little bit of charcoal, and then repeat the experiment. The silica instantly becomes reduced under these conditions, and the silicon set free combines with the platinum, forming this very fusible compound.

Having made these remarks, we may pass on to give just a *résumé* of what we said the other day with regard to silica, and it shall be exceedingly short. Silica, as we have seen, is a compound of oxygen and silicon. It exists in two very distinct states with regard to specific gravity. I am afraid that the way I put that matter before you in the last lecture may have led you to a wrong conclusion on the subject; therefore, with your permission, I will say a word or two more about it. We will divide silica into two distinct kinds. I have called the first heavy silica, having the specific gravity of 2·6. Then this is subdivided into two distinct varieties—namely, rock crystal, about the crystalline character of which there can be no mistake, and sand, which is nothing more than finely divided crystallised quartz. We have, as I told you, another variety of heavy silica of the same specific gravity, which to the eye is apparently wholly non-crystalline, but which Rose maintains, or rather designates, as crystalline, supposing it to be built up of excessively minute crystals. Under this head, we have chalcedony—of which you have a beautiful specimen before you—chrysophrase, flint, and hornstone, and I might mention other varieties, but these will suffice. All these belong to the class of heavy silica. The second division is the so-called light silica, the specific gravity of which never exceeds 2·3; and this light silica is always perfectly amorphous. It may occur even in the form of jelly, as you saw it last time, or as a perfectly non-crystalline powder, or like so much glass melted and deposited on the surface of a mineral in the form of hyalite or opal. Now, as I pointed out to you, these distinctions are exceedingly important in their bearing upon that portion of geological science relating to the formation of certain igneous rocks, of which silica is known to be an essential constituent. Then there is another distinction. The heavy silica polarises light; light silica never does; and that is a very important distinction, and one founded on essential structure. Heavy silica, so far as we know, is always produced in the wet way, that is, through the intervention of liquid reagents. This we know by direct experiment, and we have also the inferential proof, founded upon specific gravity, to which I have just directed your attention again. Then the light silica may be produced in two ways—either by separation from its compounds in the manner I showed you last time, or by fusion, all fused silica having a low specific gravity never exceeding 2· .

I will now say a few more words concerning the proofs—the mineralogical or geological proofs—(no matter which word I employ), relating to the aqueous origin of crystallised silica, and they are very conclusive. Let us look at our mineralogical cabinets, and examine the specimens of quartz which we find therein. I have one here before me, a very small one, which, unfortunately, cannot be seen by the audience at large; but if I come to examine this quartz minutely, I find that it surrounds a mineral called hæmatite, consisting of peroxide of iron and water. It is a mineral which loses its water at a very low temperature. There it is, embedded in the quartz, clearly showing that the quartz never could have been exposed to a high temperature. Here is another mineral, carbonate of iron, embedded in the quartz, and the existence of this and the peroxide clearly shows that that quartz never could have been exposed to a high temperature, and supports the conclusion at which we have arrived touching its aqueous origin. Then we find incrustations which lead to the same conclusion.

With regard to amorphous silica there is no doubt whatever about its aqueous origin. We can trace its origin in the clearest and most distinct way. In Iceland, for example, it is abundantly produced in the geysers. Here is a specimen which has been obtained from that source. Then, again, here is a specimen of granite from Iceland, on which is deposited a thin film of silica, having a pearly lustre. There is no one who will venture to say that that could have been thrown down on to the granite except by the agency of water. The specimens are very small in themselves, but, nevertheless, they speak very eloquently of the origin of silica, and tell an important tale, small as they are. Here is a very characteristic specimen showing the occurrence of crystalline quartz in two states on the very same portion of this mineral. One state is the chalcedonic, or apparently non-crystalline. I use the word *apparently*, because the substance has been found to be composed of minute crystals. Close in contact with this is the other state, which is more or less non-crystalline; and then occurs a sort of granite deposit, which, seen under a magnifying glass of high power, is seen to consist of distinctly crystalline quartz. Amorphous silica exists in the shells of living infusoria; and it is found also in a siliceous concretion, met with in the joints of the bamboo, known as tabasheer. It occurs also in petrified wood.

I will say just a word or two on the subject of flint—a subject which has recently given rise to so much discussion. You are all acquainted with the discovery of those wonderful pieces of flint and chalk, the formation of which is involved in doubt, notwithstanding that they are associated with the presence of sponge, and so on. There are, however, chemical difficulties which arise, and which will require much time to solve completely. When we take one of these dark flints, and expose it gradually to a temperature which we bring at last to a bright redness, it becomes very tender and fragile, and it would become especially fragile and perfectly opaque if heat were rapidly applied. It is in this way that the flints prepared for the use of potters are rendered fragile in the first instance, preparatory to grinding. Now, when we examine specimens of flints we are frequently struck with an opaque white outer film, where the flint has lain in contact with chalk. This film, or rind, if I may so call it, extends to a considerable depth. Well, what is it? Is there any chemical difference between this white rind and the inner dark portion of unchanged flint? This is a question which we have examined with some care, and by the aid of the most careful chemical analysis we are unable to detect any sensible difference between the two. The only conclusion, therefore, is, that the difference of appearance is owing to some molecular change, but how it is excited I am not prepared to say—whether by the slow operation of time, or whether, perhaps, by simple vibrations. It has often struck me, with regard to the flints which I have seen on the sea-shore, which have presented a white appearance, that possibly that appearance may have been caused by some operation of that kind; but upon that point I speak with the greatest possible reserve. It is of very great importance to know exactly the effect of weathering upon the surface of flints, especially with regard to the great question now agitating the public mind concerning primeval man. Here is one of those wonderful things hewn out of flint by our rude forefathers, for the loan of which I am indebted to my friend, Dr. Falconer. It presents a fracture at one end, which is very different from the contiguous portion; but then at another portion I observe the characteristic dark appearance of some of these ordinary flints. I have been examining this specimen, and upon the whole I think it must have been long exposed, subject to some condition by which the surface has been changed. Then comes the question—whether it is possible to imitate these signs of age upon counterfeits of ancient flint implements. I think a few experiments would very soon settle the point whether it is possible to give a surface very much resembling that which we find in these old weapons, by some chemical means.

With regard to the permeability of these flints by liquids, it is astonishing how pervious they are. If we immerse flint in sulphate of indigo and water, and keep it there some weeks, the indigo will penetrate to some depth.

It has been alleged, and it is a point of some importance, that silica may be volatilised, especially by the agency of steam. Every chemist knows that boracic acid, which is a fixed body, may, by the agency of steam, be vaporised to a considerable extent. A case of the volatilisation of flint was recorded, some years ago, by Mr. Julius Jeffreys. It occurred in a potter's kiln in India. His statements have been repeated by many journalists, both British and foreign. It is important that we should examine the ground upon which he arrived at his conclusion. He allowed a large quantity of steam to pass through a potter's kiln, of which the temperature more than sufficed to melt pig iron, and he afterwards observed round the opening of the kiln from which the steam escaped, several pounds of silica deposited in the form of snow. In commenting upon this statement, Berzelius, who accepted it, adduces, as a parallel case, the well-known volatility of boracic acid under the same conditions, and the fact observed by Gaudin concerning the volatilisation of silica when melted before the oxy-hydrogen blow-pipe. Now, I have examined all the original statements concerning this allegation, and I must say that the conclusion to which I have arrived is, that it is altogether unsatisfactory. There is no proof whatever, or, at all events, there is none advanced, that the deposit was silica at all. No analysis was made, and no man is justified, without the evidence furnished by analysis, in pronouncing definitely upon a point of this kind. Secondly, admitting that the substance called silica was really silica, there is no evidence to show that it was volatilised in the way described. We perfectly well know that in metallurgical operations a very large amount of finely-divided matter may be carried to a very long distance mechanically by gases or vapours floating over it. Volatilisation is something different from the mechanical removal of the particles of a substance.

I shall have occasion, when we come to speak of metamorphic action, especially of igneous rocks and so forth, to allude to silica in a state of combination.

The subject we now take up is one of great interest, which I think you will admit by-and-by, at all events. It is aluminium. This aluminium plays a most important part in this world so far as the formation of the crust of the earth is concerned. It is, as I have said, one of the chief constituents of, and forms an essential part of, all clay. It exists almost everywhere in a greater or less proportion. It is undoubtedly one of the most beautiful elements of which this world is formed, or the external part of it, rather.

Aluminium has of late excited a great deal of attention. Formerly it was known only very imperfectly, a few grains only having been obtained. Now it is produced by the hundred-weight. I have here placed before you a slab of aluminium. The metal has a bluish-grey colour. To my eye, it is intermediate between tin and zinc in point of colour, being not so white as tin, and less blue than zinc. It is by far the lightest of all metals now used in the arts, its specific gravity being in round numbers 2·5; that is to say, whatever measure of water weighs 1, the same measure of aluminium will weigh 2·5. A pint of water, we will suppose, weighs one pound, and a pint of aluminium would weigh two pounds and a-half. It is a malleable metal. It can be drawn out by rolling, or extended under the hammer with proper precautions, or drawn into wire —nay, even beaten out into thin leaf. Here is some of the leaf, and all contained in this bottle weighs only one grain. It is very fusible, but has a higher melting-point than zinc. It is very sonorous. When suspended, for example, by a string, in this way, and struck, it will ring like a bell; but when cast into the form of a bell it has proved a most signal failure. This metal alloys with several other metals, but there is only one really useful alloy which has been made with it, and I think I may say that the first hit was made in this place. It alloys with copper without the least difficulty in the proportion of about 5 per cent., and produces an alloy so like gold in colour, that even a goldsmith would fail to distinguish between real gold and the alloy of copper and aluminium. I have tried the experiment with men of experience, and they have been puzzled to say which was which. This alloy is very ductile, and is capable of a very high polish. There is one mistake prevalent in the public mind with reference to this alloy, or, at all events, an attempt has been made to mislead the public on the point. It is said that it will not tarnish. That is a mistake. It tarnishes rapidly enough, especially in our atmosphere. It is also said to have no odour; but to my taste, at all events, it certainly has distinctly the savour of copper.

Now, aluminium has a most powerful affinity for oxygen. When combined with that element it constitutes the well-known base, alumina. Like silicon, although it has this strong affinity for oxygen, yet when we succeed in detaching it from oxygen, and obtaining it in a compact, solid form, it is remarkably stable. That piece of aluminium might be exposed indefinitely to the air without undergoing oxidation to any extent. When melted, it oxidises on the surface, and forms alumina. This acts as a coating, and protects the subjacent molten metal from further oxidation.

I may just say a word or two about the mode of the formation of aluminium, because it may be interesting in other respects. It is made from a salt termed chloride of aluminium. If we take alumina, which is aluminium and oxygen, and heat it with charcoal even to a high temperature, we cannot, so far as we know, succeed in eliminating the oxygen and detaching the aluminium; but if we make the salt called chloride of aluminium, then we can, by means of a metal having a powerful affinity for the chlorine, succeed in separating the aluminium completely. The first process was to take aluminium and mix that with charcoal, and then to make the mixture into small pellets, such as you see here. Here is some alumina, and here are some pellets so made of charcoal and alumina. Now, that charcoal at a high temperature has an affinity for oxygen; and if we expose that mixture of alumina and charcoal at a certain degree of heat to the action of chlorine, we then get chloride of aluminium. We have then two affinities coming into play. We have the affinity of the oxygen for the carbon, and the chlorine for the aluminium, and by means of this twofold force we form this body, having a yellow colour, and commonly called chloride of aluminium. Well, we then place that chloride of aluminium in a glass vessel, which was the way it was formerly prepared, and expel the air by means of a hydrogen gas, and then introduce the vapour of sodium by a new application of heat to the exterior, in contact with the vapour of the chloride of aluminium. The result is the formation of chloride of sodium or common salt, and the separation of the metal which you have now before you. To describe this process properly would require diagrams, and occupy an hour and a-half. There is one other source of aluminium from a curious mineral called cryolite—one of the highest possible interest. Here is a specimen from Greenland. This consists of the elements fluorine, aluminium, and sodium. Well, to any mineralogist and chemist who reflected upon its composition, it would naturally occur that, if we could bring that substance into contact with sodium at a high temperature, we should produce aluminium. The thought occurred here some time ago, and I believe that the very first specimen produced was produced in this place. That specimen is now before you. It was shown some time ago at the Royal Institution. By the means I have spoken of we get globules of aluminium.

Now for alumina. Alumina is, as I have said, a compound of oxygen and aluminium. It contains, in round numbers, 53·3 per cent. of aluminium, and, consequently, 46·7 per cent. of oxygen, and its chemical symbol is Al_2O_3. When dry, it forms a white, tasteless powder, insipid and insoluble. Here is a specimen of it. This powder is fusible only at the very highest temperatures we can command. In fact, it is singularly infusible. In that state it is entirely amorphous. It has the property of combining with water in several proportions, producing a plastic, clay-like mass. Compounds of this kind occur in nature. One hydrate—that is to say, one water compound of alumina—occurs beautifully crystallised. That is the well-known diaspore. Then we have a non-crystalline variety in the form of Gibbsite. This diaspore is a compound of 1 equivalent of alumina and 1 of water. Gibbsite, of which you have a specimen before you, is a white, amorphous, or non-crystalline body, and is a compound of 1 equivalent of alumina and 3 of water.

Alumina crystallises magnificently, producing that glorious mineral (excuse the emphatic expression, for I think it is one that is perfectly justified) called corundum, which, when blue, is known to you as sapphire, when red as ruby, when yellow as oriental topaz, and when green as emerald. We have here a specimen of corundum which is coloured, forming these various minerals respectively. We shall speak of the mode of formation presently.

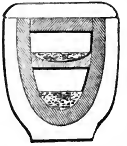
Alumina acts in the two-fold capacity of base and acid—that is to say, it unites with acids forming definite salts—and it also acts as an acid forming definite salts. It appears as common alum in the first of these states. If we take the well-known base, magnesia, or lime, or oxide of zinc, and mix them with alumina in certain proportions, we get the minerals called spinels, the alumina acting as silica would under corresponding circumstances.

There are various salts of alumina in nature, of which we shall speak presently. One of these is wavellite, or phosphate of alumina. Alumina may be precipitated easily by taking a soluble salt of alumina, dissolving it in water, and adding a little ammonia to it. It then forms a dense white precipitate. In that state it is combined with water. It is perfectly soluble in caustic potash, combining with it, and forming a clear solution.

As far as we know at present, it does not appear that the process of dialysis can have played a very important part with regard to the formation of alumina in nature, or rather in the separation of alumina. Professor Graham has spoken of the dialysis of certain salts of alumina. For instance, one of these is basic acetate of alumina, which may be decomposed by dialysis. The chloride of aluminium is another. There is, however, a salt which he has not examined at present. That is the sulphate, and that is the most likely of all to occur in nature. Therefore, for the present we have no reason to suppose, from the experiments reported, that this process has any applicability to the formation of alumina in nature.

Now, let us look at crystalline alumina. This is a subject which has a bearing upon geological phenomena. A minute crystal found in a rock shall be a clear exponent of the formation of that rock. However small it may be, it shall tell a most eloquent and indisputable story with reference to its origin. Now, I think you will agree with me that what I say is really not overstated with regard to the formation of some of the mineral constituents, though occurring in small quantity in some of our so-called "igneous" rocks.

The late distinguished, most excellent Professor Ebelmen made numerous experiments upon the subject of artificially crystallised alumina. I hold in my hands specimens which I received from him years ago. They are exceedingly small, but remarkably characteristic. Here are some small scales of alumina crystallised by the operation of fire. The process consists of heating alumina, mixed with about three or four times its weight of borax, in a small platinum crucible, under certain precautions, in a porcelain furnace—a porcelain furnace where we obtain hard porcelain, and not the so-called porcelain which we make in this country, and which is made at a low temperature. It must be the true Chinese porcelain furnace, such as was in operation at Sevres, where he experimented. He exposed the borax and alumina at a high temperature in this furnace. The borax dissolved the alumina, and after a time off went the boracic acid and the sodium. The crystallised alumina remained at last in brilliant colourless scales. These are some of those obtained by M. Ebelmen. This is exceedingly similar to what is obtained at ordinary temperatures with liquid solvents at our command. It is only just to the memory of poor old Berthier, who died not long ago, to state that I find, in looking over his papers, that he really was the first man to adopt this mode of forming mineral substances, and obtaining them in a crystallised state. He did not use borax, but he used an equivalent, namely, common salt. He formed crystallised silicate of lime and magnesia by exposing them with salt on precisely the same principle as when borax is used. We are indebted to Deville for that which is now the commonest process, and it is a very beautiful one. The operation is performed in a common crucible. I will make a rough sketch of a crucible in section, so as to give you a clear idea of what it is. Let the diagram be a section across the middle of a common crucible. Well, then, he lines that with charcoal, which is a common process,—what we call brasquing,—thus making an inner lining of charcoal all the way. Then above he puts a little capsule or cupel, made of charcoal,—a little cup-shaped piece of charcoal. He then covers the whole with a charcoal top, and afterwards places on the cover, and lutes it well down.



Now, that is the apparatus employed in this particular process. In the lower part of the crucible he puts fluoride of aluminium. In the upper part he puts fused boracic acid. He exposes the whole to a high temperature, and the two bodies vaporise. The two vapours come into contact, and they actually decompose each other; and what is the result? Why, off goes the fluorine away from the aluminium, and combines with the boron contained in the boracic acid, and then escapes as fluoride of boron, and the oxygen of the boracic acid unites with the aluminium, and forms the beautifully crystallised substance corundum. Here, then, we can make sapphire in this way most beautifully. At present our artificers have not directed much attention to it, but there is no reason why, if we carried out this branch of investigation, many of our gems might not be produced in this way.

These crystals are generally rhombohedral, terminated by the faces of the regular hexagonal prism; and, according to Deville, they possess all the optical and crystallographical properties of natural corundum. Well, then, by just varying this process, we get the true oriental ruby—not the less valuable kind called spinel, but the true characteristic ruby—simply by adding a little fluoride of chromium. The process must be conducted in an alumina crucible,—the boracic acid must be placed in a platinum cupel. Sapphire is produced in exactly the same manner, and the same colouring agent, namely, fluoride of chromium, is made use of. The reason of this is very obscure. Side by side you may get some of the crystals coloured blue, and some coloured red. The difference is possibly due to a difference in the oxidation of the chromium, but that is a point not as yet clearly revealed by analysis. It is a very peculiar thing. I have seen the same thing occur in certain experiments with glass. We know nothing by analysis of the colouring matter of the sapphire. Whatever it is, it has escaped detection by analysis. Here, by means of the same colouring agents, and under the same conditions, or apparently under the same conditions, we produce sapphire and ruby. Sometimes we find this corundum passing into sapphire, being blue in one part; and jewellers, in setting such things, try with great skill to make it appear that the colourless corundum is coloured, and they set it in such a way that the whole shall appear blue. By increasing the proportions of the chromium salt, Deville obtains a fine, rich, emerald green—an oriental emerald green corundum. This is simply by increasing the quantity of the chromium. Now, it is very peculiar that we can thus succeed in producing artificially one of the finest minerals, except the diamond. The diamond will come ultimately, I have no doubt.

Now, there is another process contrived by Debray, which appears to answer perfectly well. This consists of calcining phosphate of alumina with three or four times its weight of sulphate of soda or potash. He gets, then, tribasic alkaline phosphate and crystallised alumina.

Alumina may be melted by oxygen and the flame of a spirit lamp into glass-like beads, which are stated to be always more or less crystalline on cooling. Gaudin, especially, is the man who, many years ago, experimented upon this subject. The smallest globules show crystalline faces, and they are said to be so hard that their edges will cut glass. Sapphire, whether natural or artificial, is the hardest mineral known except the diamond. Alumina, when melted in the way I have spoken of, is said to be very liquid. By the addition of a very little chromate of potash during fusion, Gaudin obtained a more or less deeply coloured red product, similar in colour to the natural ruby. It is reported to be more or less crystalline, and to possess extreme hardness. I have some of it here in a bottle. I purchased it in Paris many years ago, and he recommended it as something marvellous for sharpening razors.

Now, how does corundum occur in nature? It is interesting to ascertain this point. It occurs frequently in limestone, forming the so-called stratified granite in Newton, in New Jersey, and in New York. It occurs in layers with marble, in the gneiss of the Isle of Naxos, and also similarly in the Isle of Lemnos, and at Magnesia, in Asia Minor. It is there associated with magnetic iron or crystallised magnetite. It occurs along with diaspore in the dolomite of St. Gothard. It occurs near Ephesus, and also in the Isle of Naxos, in the same way. Here are five specimens of corundum in its opaque common form. In its finely divided state it is known to you as emery, which is nothing more than the common form of the true sapphire. Some of the analyses of this substance give water as an essential constituent, but the sapphire and the ruby are nothing more than crystallised alumina without water. But there are analyses of some two or three specimens of corundum in which we find water given as a constituent. An analysis of corundum from Asia Minor gives 3·7 per cent. of water; and an analysis of corundum from India gives 3·1 per cent of water. In these cases, probably, they contained diaspore associated with them. There is a difficulty in many of these analyses, and we cannot extract rational formulæ of the results obtained by approximate analysis, because these crystals have the power of enclosing within their mass a very large amount of matter which in no way enters into the chemical composition of the mineral itself. It is there as so much foreign matter entangled in the crystal, and yet the crystal shall have a definite form, and so forth. There is a portion of matter which we must not take cognisance of, but we have no means of separating it mechanically from the mass. It all comes into our results, as we have no way of separating this dirt, as metallurgists call it.

Now for some examples of the so-called aluminates. You are perfectly familiar, I have no doubt, with some of these things. There is a form of ruby which is an aluminate of magnesia. It is coloured a fine rich colour, apparently with chromate of potash; but of course it is not, I think, equal to the oriental ruby. It consists of one equivalent of magnesia and one of alumina. Its formula is—$MgOAl_2O_3$, so that you see that the alumina contains three times as much oxygen as the magnesia. It may be obtained beautifully crystallised, and was so obtained by Ebelmen. It is made simply by heating magnesia and alumina with fused boracic acid, with the addition of a little chromate of potash. The experiment was made in exactly the same way as that with reference to the crystallised alumina prepared in the porcelain furnace at Sevres, near Paris, of which I have spoken to you. Ebelmen obtained in this way distinct crystals of aluminate of magnesia, having a fine ruby red colour. They are exceedingly small, but they are, nevertheless, instructive, small though they be. Here is one of the specimens obtained by Professor Ebelmen. Then, by adding a little cobalt, he obtained crystals of the same form, having the characteristic and beautiful blue colour of the natural mineral.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

MICROSCOPICAL SECTION.

October 19, 1863.

Professor Williamson *in the Chair.*

A letter from Captain J. Mitchell, dated Madras, May 13, 1863, was read, of which the following is an extract:—"The view that the universal form of cotton hairs is a flattened fibre consisting of scarcely anything but membrane is by no means novel; for much the same description of the cotton fibre has been given by Quekett, Henfry, and many others. Indeed, that opinion is general. Almost every one you ask will tell you that the cotton fibre is flat and twisted, or perhaps a flat spiral. That this is not the general form of the hairs of good cotton any microscopist may satisfy himself in five minutes. An examination of many varieties of cotton has led me to believe that in those descriptions which find most favour in the English market there is a very large proportion of hairs that are entirely or nearly filled with secondary deposits; and on the contrary, in the low-priced cotton, the flat fibre consists of hardly anything but membrane; in fact, an apparently undernourished cell predominates. The knotty portions, which I believe are considered refuse, consist almost entirely of these flat fibres. I believe that the absence of secondary deposit is an indication of careless culture, or, what is much the same thing, of a poor soil."

November 16, 1863.

J. Sidebotham, *Esq., President of the Section, in the Choir.*

The President exhibited some spurious gold slides, on which he remarked that the first offered for sale were made by rolling gummed sand in gold leaf, some even more roughly, by dabbing gold leaf on sand gummed to the slide; whereas, the practice now appears to be to electro-plate plumbago, the result of which, however, differs from the nugget-like form of real gold by being nicely broken off at what would be the angles. Some very good imitations were made by boiling plumbago in oxalic acid and chloride of gold.

Mr. C. O'Neil stated that very beautiful spires of gold were observable on the surface of auriferous quartz boiled in carbonate of soda, and then submitted to the action of heat for a short time under the muffle.

ACADEMY OF SCIENCES.

December 28, 1863.

The last sitting was occupied with the announcement of the prizes conferred by the Academy for 1863.

The Jecker prize of 5000 francs, founded to encourage the study of organic chemistry, has been bestowed on Dr. Hofmann, for his works relating to the artificial organic alkalies.

Montyon prizes, of 1500 francs, were conferred on M. Guignet for his green colour, and another on M. Bouffee for inventing a mixture of picric acid and M. Guignet's *vert de chrome*, intended to supersede the use of arsenite of copper.

NOTICES OF BOOKS.

The Quarterly Journal of Science. Edited by J. Samuelson and W. Crookes, F.R.S. January, 1864. London: Churchill and Sons.

We can, of course, do little more than call attention to the contents of this Journal. They are of a varied character, and all relate to subjects of interest and importance. The scientific survey which forms the introduction gives an able *resumé* of the present state of our knowledge on all branches of natural science; and the chronicles of science, which will always form a considerable section of each number, will carry it on to the latest discovery before the date of publication. The Journal will, therefore, be indispensable to the scientific readers who wish to keep well up with the march of events.

The published list of contributors shows that almost every man eminent in science is disposed to co-operate in placing the *Journal of Science* at the head of the scientific periodicals of the day.

Manual of the Metalloids. By James Apjohn, M.D., F.R.S., &c., &c., Professor of Chemistry in the University of Dublin. London: Longman and Co. 1864.

This volume forms one of the series of manuals on different branches of science, edited by Messrs. Galbraith and Haughton; perhaps the best series of scientific educational works which has issued from the press. The present work worthily maintains the character of the series; but, as a student's "handbook in chemistry," it has the fault of being at once too long and too short. As a "Manual of the Metalloids" it is excellent, including, as it does, almost everything relating to those bodies which it is important to know. A manual of metals, from the same hand, we hope will soon follow; and the two together will constitute a valuable introduction to the study of chemistry.

The term *metalloid* was applied by Berzelius to all the non-metallic elements, but does not seem always appropriate. Its use, however, is sanctioned by the best authorities, and we shall not quarrel with it, nor stay here to discuss the propriety of applying it to other bodies, such as arsenic. Our author restricts the term to those bodies which have always been considered as non-metallic.

The most noticeable part of this work is the introduction, which gives a most lucid account of the principles of chemical philosophy, and we recommend an earnest study of this part to the student.

An admirable review of Gerhardt's system of notation is included, and with regard to this we find the following remarks, which are important, as coming from one of our most successful teachers of chemistry. "After the review which has been taken of the unitary system, there remains little to be added in the way of commentary. The writer of these pages does not object to the doubling of the equivalents of certain of the simple substances (it was long since done in the case of oxygen by Berzelius and Davy), but feels that, after this step is taken, the elements cannot be concluded to have *all* the same atomic volume, for there are several of them of whose specific gravities we are entirely ignorant; and there are three of them—phosphorus, arsenic, and selenium—whose densities have been well determined, and are known to be inconsistent with such a simple law—[*i.e.*, that the atomic volumes of all the simple substances are equal]. The atomic weights of the substances in question being doubled, the atomic volumes of compound bodies will, generally speaking, be equal; but this is not invariably the case; and, to adopt as a general conclusion a proposition affected by numerous well-established exceptions, would appear to be a course quite at variance with the genius of a purely experimental science. The remaining postulate of the unitary system—that the molecules of the simple bodies are composed of atoms associated in pairs—is certainly of a questionable nature. It is not sustained by direct experimental evidence, and does not conduct to any practical results of such importance as would justify its adoption; for it is but a feeble argument in its support that, if received, the molecular volume of most simple, and the atomic volumes of most compound bodies, would become equal to each other. But even though this and other difficulties could be surmounted, grave doubts may be entertained of the expediency of making Gerhardt's theory the exclusive basis of instruction in chemistry. The existing method seems entitled to preference from its comparative simplicity, and because of its resting exclusively on experimental evidence."

Several other passages both in the introduction and body of the work offer themselves for quotation and comment, but we must content ourselves with recommending the book to the intelligent student as one of the very best to which he can devote his attention.

The Pharmacopœia of the United States of America. Fourth Decennial Revision. By Authority of the National Convention for revising the Pharmacopœia held at Washington A.D. 1860. Philadelphia: Lippincott and Co., 1863.

(*Continued from page* 11.)

Among the *Resinæ*, a class of resinous extracts introduced into this Pharmacopœia, we find Resina podophylli. This is directed to be prepared by simple percolation of the May apple with spirit, evaporating the tincture, and precipitating the resin by means of water. As it will be introduced into the British Pharmacopœia, it is not necessary to say more about it at present. A Resina scammonii also finds a place in the American work, and, considering the variable quality of scammony, this preparation is perhaps the most reliable form in which the medicine can be exhibited. It is directed to be prepared from commercial scammony, and not from the root. The scammony is exhausted by successive treatments with boiling alcohol; the mixed tinctures are then concentrated, and the resin precipitated by means of water.

The form given for the preparation of Spiritus etheris nitrosi may be recommended as an improvement on that given by the London College in 1851. Careful directions are given for the preparation of a strong alcoholic solution of hyponitrous ether, which is then rectified with a small proportion of carbonate of potash, and afterwards diluted by the addition of more alcohol. The directions, if carefully followed, will probably give a preparation of pretty uniform strength. It is said to have the sp. gr. ·837, and to contain from 4·3 to 5·0 per cent. of its peculiar ether. It is also directed to be preserved in well-stoppered half-pint bottles, and protected from the light.

Spiritus ammoniæ aromaticus is to be made in the way about to be introduced into our own Pharmacopœia. Carbonate of ammonia is dissolved in water with some liquor ammoniæ, the essential oils are dissolved in alcohol, and the two solutions are mixed together. This of course will give a preparation of definite strength and density.

Some of the syrups are very useful and elegant preparations. Among them we notice a Syrupus rhei aromaticus, which must be a nice form for the administration of the medicine to children.

It is made as follows:—

"Take of rhubarb in moderately fine powder, two troyounces and a-half; cloves, in moderately fine powder; cinnamon, in fine powder, each half a troyounce; nutmeg, in moderately fine powder, one hundred and twenty grains; syrup, six pints; diluted alcohol, a sufficient quantity. Mix the powders, and having moistened the mixture with two fluidounces of diluted alcohol, introduce it into a conical percolator, and pour diluted alcohol until a pint of tincture has passed. Add this to the syrup previously heated, and mix them thoroughly." "Syrup," we should add, is thirty-six troyounces of sugar dissolved in water to make two pints, twelve fluid ounces, or, by weight, fifty-five troyounces.

Syrupus scillæ compositus is no doubt a very useful cough medicine, and may be of some interest to our readers at this period of the year, so we insert the formula in another place. In estimating the dose, they must remember that the American pint consists of sixteen ounces, and consequently each ounce of the syrup will contain one grain of tartar emetic.

Among the *Tinctures* we do not find much to remark upon. Tinctura ferri chloridi is here directed to be prepared by dissolving iron wire in hydrochloric acid, the solution being peroxidised by means of nitric acid; the spirit is afterwards added to the cold liquid.

A novelty to us is a Tinctura opii deodorata. In this preparation a fluid extract of opium is first made, and this is treated with ether. The ethereal solution which separates is rejected, and the remaining extract is again dissolved in water, filtered, and then mixed with the alcohol. The advantages of this preparation, if it have any, are unknown to us.

Among the *Trochisci*, we find a recipe for Trochisci cubebæ, which is no doubt a useful and not disagreeable form of dragée. We shall quote the formula elsewhere.

The ointments and wines offer nothing for notice. The list of preparations concludes with those of zinc, and among them we find directions given for making acetate of zinc, by keeping a solution of acetate of lead in contact with metallic zinc, which, we may state, is by no means a satisfactory way of making a pure salt of zinc.

The last feature of the work we shall call attention to is the carefully compiled index, in which the "names are so marked for the quantity of the syllables, that it may serve as a pronouncing vocabulary of the Materia Medica." Here the young pharmaceutist may see how to pronounce "Crē'ta" and "Ichthȳŏcol'la;" and the older one who meets with the word for the first time need be in no difficulty about the pronunciation of "Cim'içif'ŭga."

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

2855. Lauchlan Mackirdy, Greenock, Renfrewshire, "Improvements in saturating, washing, and cleansing charcoal and other matters, applicable also to the separation of syrups from sugar."

2875. Richard Archibald Brooman, Fleet Street, London, "Improvements in the manufacture of salt, and in boilers to be fed by salt water."—A communication from Charles Louis Edouard Lequin, Nancy, France.—Petitions recorded November 16, 1863.

2383. John Bailey, Salford, George William Blake, Manchester, and William Henry Bailey, Salford, Lancashire, "Improvements in barometers, gas regulators, and other apparatuses for regulating and indicating the flow and pressure of liquids and fluids." Petition recorded September 28, 1863.

2812. Andrew Craig, Rock Ferry, Birkenhead, Cheshire, "Improvements in distilling hydrocarbons from coal, shale, and other bituminous substances, and in apparatus employed for that purpose."

2839. James Medway and Samuel Joyce, Owen's Row, London, "Improvements in the manufacture of starches by the introduction of colouring-matters."

2852. William Edward Newton, Chancery Lane, London, "Improvements in the treatment or manufacture of wrought and cast iron and steel." A communication from Marc Antoine Augustin Gaudin, Rue St. Sebastien, Paris.

2864. Charles Pengelly, Bodmin, Cornwall, "Improvements in mechanism or apparatus for reducing or pulverising ores and other substances required to be reduced or pulverised."

2866. Gilbert Thonger, Birmingham, "Improved modes of preventing accidents arising from the sale or use of poisons."

2886. William Mattieu Williams, Oak Alyn, near Wrexham, Denbighshire, "Improvements in apparatus for the distillation of coal and peat, and such other substances as are or may be used for the manufacture of solid and liquid volatile hydrocarbons, or for the manufacture of the said hydrocarbons and coke."

2888. William Wigfall and Gottlieb Jolly, Sheffield, "An improved explosive compound to be used in the manufacture of cartridges, and an improved mode of manufacturing cartridges therewith."

2894. Heinrich Hirsel, Terminus Hotel, London Bridge, Southwark, Surrey, "Improvements in the manufacture of colouring-matters suitable for dyeing and printing." Petitions recorded November 18, 1863.

2739. Richard Smith, Glasgow, Lanarkshire, N.B., "Improvements in preparing or obtaining colouring matters."—Petition recorded November 5, 1863.

2903. John Kirkham, Euston Road, London, "Improvements in the treatment of certain ores of iron."

2912. George Rait, Canal Bridge, Kingsland Road, and John Winsborrow, Castle Terrace, Pownal Road, Dalston, Middlesex, "Improvements in the construction of dry gas meters, and in the means or apparatus employed therein."

2931. Ferrar Fenton, Camberwell, Surrey, "Improvements in the treatment of vegetable fibres for the production of paper pulp or half stuff therefrom."

2951. Davis Wilson Rea, Upper Thames Street, London, "Improvements in preserving animal and vegetable substances."

Notices to Proceed.

1908. Richard Edwin Bibby, Manchester, "An improved fire-proof cement, which may be employed for covering walls, ceilings, and floors, and is also applicable in the manufacture of fire-bricks, crucibles, retorts, melting pots, and for other purposes where fire-resisting properties are required."—Petition recorded August 1, 1863.

1821. Carl Heinrich Roeckner, Richmond Terrace, Clapham Road, Surrey, "Improvements in machinery and process for reducing wood to a fibrous condition for the manufacture of paper stuff or pulp."

2093. Louis Guillemot, Rue du Moulin à Vent à Poitiers, Vienne, France, "An improved machine for obtaining perpetual motion."—Petition recorded August 24, 1863.

2172. Frederick Charles Phillip Hoffman, Newgate Street, London, "Improvements in machines for crushing hard substances, for washing ores and minerals, and for separating earth and earthy matters from solid substances."—Petition recorded September 2, 1863.

2746. Henry Bessemer, Queen Street Place, New Cannon Street, London, "Improvements in the manufacture of malleable iron and steel, and in the apparatus employed in such manufacture."

2758. Joseph Townsend, Glasgow, Lanarkshire, "Improvements in the manufacture of nitrate of potash."—Petition recorded November 6, 1863.

2781. Hippolyte Mege, Rue de la Fidélité, Paris, "Certain improvements in the manufacture of soap."—Petition recorded November 9, 1863.

CORRESPONDENCE.

On Scientific Contributions.

To the Editor of the Chemical News.

Sir,—In your impression of Saturday last I perceive a letter from Mr. Draper, apologising to Mr. Spiller for an apparent appropriation of his ideas relative to the Metallic Citrates, which is very creditable to him. I could have wished that a similar act of courtesy had been extended to me in reference to my papers on Nitrates, as neither in the Chemical News nor the *Transactions of the Chemical Society* have I seen any notice, notwithstanding I wrote a letter about it to the President. I had thought, from the extensive circulation of the Chemical News, that one could hardly have failed being acquainted with the prior publication of my paper, particularly as it was of such recent date as to be fresh on the memory; and that, if Dr. Sprengel was really not aware of it, some other member of the Chemical Society would have reminded him of the similarity of our papers; or else what good, or what encouragement, is there in the publication of the results of one's labours, if they are neither read nor acknowledged?

I am, &c. John Horsley, F.C.S.

MISCELLANEOUS.

Thallium.—The following *canard* has been extensively circulated during the past week; it originated with the *Mining Journal*, and speaks more for our contemporary's inventive faculty than for his scientific knowledge:—"It is reported, upon good authority, that a distinguished German chemist has just made an important discovery in connexion with the alloy now generally designated thallium. It appears that, amongst the most ancient records of the ancient Mexicans, an account is given of the mode of preparing the alloy used for producing the brilliant green fire which was freely burnt during the sacrificial ceremonies in honour of Vitzliputzli, one of their principal deities, and that in the attempt to prepare a similar alloy, from the details given, a discovery, opening up an entirely new field of chemical science, has been made. By the peculiar treatment of certain proportions of silver, lead, and selenium, a black powder was produced, so much resembling that designated thallium by Mr. Crookes, that the experimenter was induced to test it. The weight of alloy was precisely equal to that of the metals used, yet the whole of the reactions of thallium were obtained, and salts, bases, and acids of the alloy were produced, precisely as if the alloy had been a perfect metal. Even in the spectroscope the well-known green line was produced. The fact of selenium entering so largely into the alloy is considered to account for Mr. Crookes supposing the so-called thallium to belong to the sulphur group, until M. Lamy showed him the alloy in its metallic state, and proved it to be nearer to silver and lead. Whether the whole of the powders hitherto considered to be pure metals in the pulverulent state are simply alloys has yet to be ascertained. It will be an interesting subject for research, whether chemistry or electricity give an alloy these peculiar qualities. It is anticipated that some tons of thallium will be ready for sale in England at less than the price of silver in the course of a few weeks."

Syrupus Scillæ Compositus, Compound Syrup of Squill—Take of squill in moderately coarse powder, seneka in moderately fine powder, each four troyounces; tartrate of antimony and potassa, forty-eight grains; sugar, in course powder, forty-two troyounces; diluted alcohol water, each, a sufficient quantity. Mix the squill and seneka, and, having moistened the mixture with half a pint of diluted alcohol, allow it to stand for an hour. Then transfer it to a conical percolator, and pour diluted alcohol upon it until three pints of tincture have passed. Boil this for a few minutes, evaporate it by means of a water-bath to a pint, add six fluidounces of boiling water, and filter. Dissolve the sugar in the filtered liquid, and, having heated the solution to the boiling point, strain it while hot. Then dissolve the tartrate of antimony and potassa in the solution while still hot, and add sufficient boiling water, through the strainer, to make it measure three pints. Lastly, mix the whole thoroughly together.

Trochisci Cubebæ.—Take of oleoresin of cubeb a fluidounce; oil of sassafras, a fluid drachm; liquorice, in fine powder; gum arabic, in fine powder; sugar, in fine powder, each three troyounces; syrup of tolu, a sufficient quantity. Rub the powders together until they are thoroughly mixed; then add the oleoresin and oil, and incorporate them with the mixture. Lastly, with syrup of tolu form a mass, to be divided into troches, each weighing ten grains.—*American Pharmacopœia.*

Spiritus Ammoniæ Aromat.—In consequence of an accident a number of typographical errors occurred in the article with the above heading, published last week. The reader is, therefore, requested to make the following corrections:—Page 5, omit the line *Spt. Amm. Aromat.*; in the following line, for *are* read *is*. Page 6, col. 2, fifth line, for *primary* read *passing*; line 8, for *experiments* read *experiment*.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

J. J.—The paper will appear in our next number.

Reader.—A different treatment is required in most cases. Give us a definite example, and we will give you the information.

A Subscriber.—Sulphide of carbon is a good solvent.

J. D.—See sundry papers in Vol. VI. Chemical News.

Received.—M. B., W. B., H. H., next week.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Separation of Stannic and Tungstic Acids, *by* C. Rammelsberg.[*]

According to H. Rose,[†] these acids may be separated by heating them in a stream of hydrogen. When the reduction is attempted in a porcelain crucible, a loss is always experienced, arising from the oxygen of the stannic acid, which is reduced to metal, and a third of the oxygen of the tungstic acid, which changes to tungstic oxide. By boiling in hydrochloric acid, the tin is dissolved, and can be precipitated by sulphuretted hydrogen, while the tungstic oxide is reconverted into tungstic acid by ignition in the air.

After analysing the compound of stannic and tungstic acid with iron and manganous oxide, described in the memoir mentioned below, I was induced to investigate this method, and first of all employed weighed quantities of the two acids.

I. 1·065 of pure stannic acid and 2·375 of pure tungstic acid lost, after the first half hour's ignition (at about a temperature at which, under equal conditions, tinstone would be reduced), 0·43. At a stronger heat, 0·115 more; together, 0·445. And by a still longer continuation of the process, 0·085; total, 0·63.

100 parts of the mixture employed contained—

		Oxygen.	
Stannic acid .	30·96	6·625	6·625
Tungstic acid .	69·04	14·291⅓ =	4·764
	100·00	20·916	11·389

If, therefore, the stannic acid was reduced to metal, and the tungstic acid to oxide, the loss should amount to 11·39. Instead of this, however, the loss after the first heating amounted to 12·50 per cent.; after the second, 15·84 per cent.; after the third, 18·31 per cent. Thus, at the commencement, a portion of metallic tungsten was produced, the proportion of which naturally increased afterwards.

The residue ought to have given with hydrochloric acid only a colourless solution of chloride of zinc; but, instead of this, it gave first a blue and then a brown solution, while a part remained undissolved, which, by heating in the air, formed tungstic acid. The brown solution was filtered, but, after dilution, it became decolorised, and deposited yellow tungstic acid.

It appears, therefore, that it is difficult to conduct the operation so as to ensure the reduction of the tungstic acid only as far as the oxide WO_2, and quite as difficult to separate the same from metallic tin by hydrochloric acid.

II. To ascertain whether the strong heat of a gas lamp would also effect a complete reduction of tungstic acid, 1·222 of stannic acid and 1·803 of tungstic acid were strongly ignited in hydrogen gas. The loss of weight after the first ignition was 0·491; after the second, 0·631; and after the third, 0·645.

100 parts of the mixture contained—

		Oxygen.
Stannic acid . . .	40·4	8·645
Tungstic acid . . .	59·6	12·337
	100·0	20·982

The loss of weight in the above experiment, expressed in percentages, were as follows:—After first heating, 16·23; after the second, 20·86; after the third, 21·32. The last number is somewhat higher than the calculation requires, probably in consequence of the volatilisation of some of the tin. In this case the reduction was complete. The grey pulverulent mass contained white, malleable granules of tin, gave a colourless solution with hydrochloric acid, and left a black residue, which, ignited in the air, gave 0·778 of yellow tungstic acid, answering to 58·78 per cent. (Loss 0·82 per cent.)

III. 2·212 of stannic acid and 2·116 of tungstic acid lost, after several hours' strong ignition, 0·88 = 20·33 per cent.

The mixture contained—

		Oxygen.
Stannic acid . . .	51·11	10·937
Tungstic acid . . .	48·89	10·120
	100·00	21·057

In this instance, therefore, the reduction was almost complete.

Rose's method may also be employed under the supposition that the tungstic acid is reduced to metal. This point, however, cannot be ascertained by a constant weight of the residue, inasmuch as, in consequence of the volatilisation of the tin, the weight continues to diminish. For the same reason the direct estimation of the tin by this method is impossible.

Rose, who has shown[‡] that stannic acid, when ignited with sal-ammoniac, is completely volatilised, states also that under the same circumstances tungstic acid remains unchanged, but that, in the presence of alkalies, tungstic oxide, tungstenamid, and nitride of tungsten are formed. I have employed chloride of ammonium as a means of separating quantitatively the two pure acids, and have obtained satisfactory results.

As the conversion of stannic acid into volatile chloride of tin requires a long time, the treatment of the mixture with six or eight times its weight of sal-ammoniac must be repeated several times, until no further loss of weight is observed. Great care must be taken that the outside of the porcelain crucible and cover does not become overspread with stannic acid, which is formed afresh from the chloride and surrounding moisture. Hence the smaller crucible should be placed in a larger one similarly covered, and heated to tolerably high temperature. The residue of tungstic acid is soon coloured green, then blackish; when heated in the air it becomes yellow, and has a constant weight.

I. 0·6977 stannic acid and 0·7335 of tungstic acid gave a final residue of 0·7225, which, after ignition in the air, weighed 0.7255. The difference amounts to 0·008; that is, instead of 51·26 per cent., only 50·7 per cent. was obtained.

II. 0·554 stannic acid and 1·332 tungstic acid left behind 1·337 of the latter; that is, instead of 70·62 per cent., I recovered 70·89 per cent.

I have employed this method for the separation of the two acids in the combination mentioned at the commencement of this paper.

On Solution, *by* Barnard S. Proctor, *Esq.*

While experimenting in August, 1860, I had occasion to mix 4 drachms of commercial carbonate of potass (not bicarbonate) with 7 fluid drachms of strong liquor of ammonia, ·880 sp. gr. I was surprised to find so deliquescent a salt settle to the bottom with little appearance of solution. It had simply become moist, and disengaged a little gaseous ammonia.

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[*] *Annalen der Physik und Chemie*, Bd. cxx., 66.

[†] "Traité Complet de Chimie Analytic. Analyse Quantitative." Paris, 1861. P. 486. *Dexter Ann. der Physik und Chemie*, Bd. xcii., s. 335.

[‡] *Op. cit.*, vol. i., p. 234.

After thirty hours' contact, a small portion of oily-looking solution floated between the carb. potassa and the liquor of ammonia. A little of the ammoniacal liquor on evaporation left a small fixed residue. Seven drachms of rectified spirit of wine were then added to the former mixture, and were found to expedite the solution of the carbonate of potass, the whole being dissolved in the course of an hour, forming a heavy solution not miscible with the ammoniacal liquor.

It was conjectured that the presence of the spirit might prevent the intersolubility of the two solutions; and to ascertain whether or not this was the case, two measures of a saturated aqueous solution of carbonate of potass, and one measure of strong liquor of ammonia, were agitated together. As complete separation appeared to take place, the proportions were reversed—that is, two parts of the ammoniacal to one of the potass solution—but with the same result. The proportion of the ammonia was gradually increased till it amounted to about thirty times the measure of the potass solution, at which point the potass liquor dissolved in the ammoniacal.

I then thought it interesting to know to what extent the ammoniacal liquor would dissolve in the carbonate of potass solution, for which purpose 180 minims of the latter solution were taken and 10 minims of liquor of ammonia added, which readily dissolved. Further additions were then made, 10 minims at a time, at every fifth addition the solutions being allowed to stand for five minutes.

In this manner, 140 minims were added before permanent turbidness was produced, the last four additions having produced milkiness and partial separation at the point of contact of the two solutions, until they were shaken, when perfect solution was effected. A further addition of 10 minims gave a permanent turbidness, resulting in a separation of the fluid into two solutions, the bulk of the heavier being to that of the lighter as 210 to 110—that is, the potass solution had gained 30 minims and the ammoniacal liquor had lost 40, the separation of the two being as distinct as the separation of oil from water. On standing twenty-four hours, re-solution appeared to be taking place, the line of contact being much less visible, and appearing like that of two intersoluble liquids, as proved to be the case, perfect solution taking place on agitating them. During the twenty-four hours, a small, heavy, crystalline precipitate had deposited, probably carbonate of potass.

More ammonia was then added in the same manner as before, to the extent of 70 minims, before separation again took place, the bulk of the heavy liquid now being 115 and the light being 275—that is, the potass solution had lost 65 minims and the ammonia gained a similar bulk. On re-agitating and settling, the potass solution increased in bulk again, and, in the course of twelve hours, re-solution of the two liquors was again taking place.

With the desire of making the separation of the two solutions more visible, I purposed colouring the ammonia with sulphate of copper; but here again I met with unexpected results, for the immersion of a crystal of the sulphate scarcely tinted the ammonia; the crystal itself becoming coated with a dark blue crust.

A small quantity of a saturated solution of sulphate of copper was then added to the ammonia; a blue precipitate was produced, which was, contrary to expectation, almost insoluble in the excess of ammonia present.

A small crystal of nitrate of copper was found to dissolve freely in the ammonia, affording the deep blue liquor which was desired, and with this solution I hoped to render more conspicuous the separation of the potass from the ammonia; but again my experiment proved less successful, though not less interesting, than I anticipated, for on the separation taking place the potass liquor was found deep blue, and the ammonia almost colourless.

Though the results I have indicated with solutions of carbonate of potass and ammonia are very remarkable, they are not so completely isolated as I at first thought.

That two aqueous solutions should not be soluble in one another, or readily miscible in all proportions, is a fact which would be thought striking by most chemists at first sight; but, on closer attention, we find several well-known phenomena of a somewhat similar nature.

The solubility of ether and water, which I before noticed, is a case in point: both the heavier and the lighter portions may be regarded as aqueous solutions. Again, the familiar case of carbonate of potass being added to weak spirit, a dense aqueous solution is formed at the bottom, and the supernatent liquid may be regarded as an aqueous solution of alcohol.

I also find that a saturated solution of oxalate of potass is not a solvent of a saturated solution of potass soap; and this leads us to the fact made use of in the soap works, that a concentrated solution of caustic soda is not a solvent of curd soap; so we find links in the chain sufficient to connect these new observations with other chemical facts well known and usefully applied.

I have sought to multiply instances of this species of insolubility with the hope of deducing a law, but I have as yet only met with one other salt—the soluble silicate of soda—which is not intersoluble with the aqueous ammonia.

I thought to find some solution which would compare with ammonia in its action, but as yet have found none, unless, as I just now suggested, we look upon ordinary spirit as a solution of alcohol. I have found four other salts, whose saturated solutions settle in spirit, like the carbonate of potass, without mixing, namely, phosphate of potass, citrate of potass, citrate of ammonia, and silicate of soda. Besides these, solutions of various other salts, which are less deliquescent, settle in the spirit, more or less speedily give up their water, while the salt itself is deposited in crystals. In this respect, also, the spirit and the ammonia resemble each other. Of eleven solutions of very soluble salts which are caused to crystallise by being poured into spirit, four crystallised on being poured into ammonia, namely, carbonate of soda, sulphate of soda, Rochelle salt, and chromate of potash.

The most interesting case of crystallisation which I have observed is that of carbonate of soda. Spirit abstracts the water from a cold saturated solution of carbonate of soda, causing immediate crystallisation, but a hot saturated solution settles in the spirit, without mixing or undergoing crystallisation; and even after cooling and standing for several hours the solution remained fluid and separate from the spirit, until, a small crystal having been dropped in, rapid crystallisation took place, the water of the solution then, of course, uniting with the spirit.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, *F.C.S.*

(Continued from page 16.)

Some of the more important of the forty-three experiments detailed in the treatise we are considering, are given below:—

In the first experiment Boyle explains by what means the receiver of his air-pump is exhausted, and he affirms that most of the experiments which he is about to relate, may be explained by bearing in mind the fact, "that there is a spring or elastical power in the air we live in."

He compares the air to a fleece of wool, or a dry sponge,* or says we may admit Des Cartes' theory, that the air is made up of innumerable flexible particles, which are so moved about by the motion of the celestial matter in which they swim, that each particle keeps those around it at a distance. Boyle prefers to believe that the air itself is elastic, rather than to admit Des Cartes' theory.

The height of the atmosphere, according to Kepler, is only eight miles, but Ricciolo makes it probable that it extends to a height of fifty miles. Can we not, therefore, well imagine, writes Boyle, that the weight of a column of air of such a height will keep "the little springs" of the air bent, and that when that weight is removed they will straighten themselves.

Experiment 2. When a stoppered receiver was exhausted of air, great force was found to be necessary to remove the stopper.

From the length at which this experiment is detailed it would appear that Boyle had not heard of the Magdeburgh hemispheres, although they were invented several years previously.

Experiment 4. A half-blown bladder placed in the receiver became fully expanded on exhausting.

This experiment had been previously tried by Roberval, by introducing a nearly empty carp's bladder into the Torricellian vacuum.

Experiment 5. When the exhaustion was long continued the bladder burst; a partially-filled bladder also burst when held near a fire.

Experiment 6. In order to determine to what extent a known quantity of air could be made to expand, when pressure was removed from it, Boyle took a phial containing four or five drachms, tied an empty lamb's bladder over its mouth, and placed it in the air-pump receiver; exhaustion was continued until the bladder was fully expanded, and by comparing the capacities of the phial and bladder, the air was found to have expanded to nine times its original bulk.

This mode of experimenting was evidently borrowed from Bacon, who, in the 40th Aph. of Book 2 of the "Novum Organum," describes an experiment which he made in order to determine the space occupied by the vapour produced from a liquid occupying a known space; in other words, the ratio between the spaces occupied by a substance when in the liquid and gaseous states. This experiment, although it could only give most fallacious results, is well worthy of record, inasmuch as it was made at a time when experiments of any kind were rare, and quantitative experiments most rare.

Bacon filled an ounce phial, of known weight, with the lightest liquid with which he was acquainted (spirits of wine), weighed, to determine the amount of spirit taken, and tied an empty bladder, containing about two pints when full, over the mouth of the phial; the spirit was heated until the bladder was fully expanded, when the heating was discontinued, the bladder pricked to allow the vapour to escape, and then removed from the phial; on reweighing the phial, the amount of spirit converted into vapour was found, and the space it occupied being compared with the contents of the bladder, it was shown that the spirit of wine occupied in the state of vapour 100 times the bulk it possessed in the liquid form.

But we must return to Boyle's experiment on the expansion of air under diminished pressure. After making the experiment with the bladder and phial, he devised a far more accurate method, which was to place within the receiver a tube, closed at one end, to which a divided scale was attached, and the capacity of which was known. The tube was entirely filled with water, with the exception of the space occupied by a small quantity of air of known bulk, and its lower end was placed in a vessel of water. When pressure was removed, the air within the tube expanded and depressed the column of water, and the amount of expansion was shown by the scale. By this means it was found that air expanded to thirty-one times its bulk, but the tube was too short, and the air still continued to expand, when the experiment had to be stopped. He next made use of a tube three feet long, passed it air-tight through the cover of the receiver, and placed the phial of water, into which its open orifice dipped, within the receiver; a known quantity of air was now found to expand to 152 times its previous bulk; it is obvious, however, that the inaccuracy of the experiment increases with the length of the tube, because, when the exhaustion has proceeded to a certain extent, the column of water will fall, not only on account of the expansion of the air above it, but also because its own weight can partially overcome the pressure of the rarefied air in the receiver.

Experiment 7. A small globe of very thin glass, filled with air, was placed in air-tight connexion with an exhausted receiver: on suddenly turning the stop-cock so as to open free communication with the receiver, the globe was not broken, probably, Boyle says, on account of its shape.

Experiment 8. The helmet of a glass alembic was fitted with a stop-cock, every other part being closed; the shank of the stop-cock was cemented into the upper orifice of the pump-barrel; on exhausting, the helmet was broken.

Experiment 9. A glass tube, open at both ends, was cemented firmly into the neck of a glass phial containing a small quantity of water, so that its lower end reached nearly to the bottom of the phial; the latter was placed in a small receiver, and the tube passed air-tight through the cover; on exhausting, the phial was burst,† because, says Boyle, the inside of the phial had to bear the whole weight of the atmosphere, and there was no corresponding pressure to counterbalance it on the outside. The thinnest glass vessel is not broken in the air, because both the inside and outside are equally pressed; in other words, it is submitted to no pressure at all.

Experiment 10. A lighted candle was placed in the receiver; on exhausting it was extinguished. When burnt in the closed receiver, without exhausting, it continued alight for a much longer time.

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* Hero of Alexandria, who was acquainted with the elasticity of the air, compares it to horn shavings, or a sponge. See the first of these papers, CHEMICAL NEWS, vol. viii., p. 115.

Pascal, as we have seen in the previous paper, compared the air to wool, a favourite simile of Boyle's throughout his work, but whether taken from Pascal or not it is difficult to say. Pascal's treatise "On the Weight of the Mass of Air," was not published till 1663, but Boyle may have heard of the comparison from some one who had conversed with Pascal.

† The phial burst with such violence that it cracked the air-pump receiver,—a not unfrequent occurrence, however, from other causes; and, as receivers were difficult to procure, Boyle was in the habit of covering the cracks with cement, and afterwards with diachylon plaster. The following is his account of the preparation of the cement:—"The plaister was made of good quicklime, finely poudred, and nimbly ground with a pestle in a mortar, with a quantity (I know not how much precisely, not having the essays in this place) of scrapings of cheese, and a little fair water, no more than is just necessary to bring the mixture to a somewhat soft paste, which, when the ingredients are exquisitely incorporated, will have a strong and stincking smell. Then it must be immediately spread upon a linnen cloath of three or four fingers' breadth, and presently apply'd, lest it begin to harden. But if your Lordship had seen how we mended with it receivers, even for the most subtile Chymicall spirits, you would scarce wonder at the service it hath done in our Pneumaticall Glass."

Experiment 11. A wire basket, filled with ignited charcoal, was suspended in the receiver; on exhausting the charcoal ceased to glow sooner than when the receiver was not exhausted; but a piece of red-hot iron did not appear to lose its redness sooner in a vacuum than when placed in the closed receiver.

Experiment 12. A piece of lighted match, "such as soldiers use," was placed in the receiver; it was quickly extinguished, and an immense quantity of smoke was produced.

Experiment 13. In order to see whether the match was extinguished for want of air, or because the smoke pressed upon it, and stifled the flame, a partially-blown bladder was introduced with the match, to see if the fumes exerted appreciable pressure, but the bladder expanded quite as readily as when it was placed in the receiver without the match.

Experiment 14. Gunpowder could be fired in an exhausted receiver, and a flint and steel meeting together in collision produced sparks.

(To be continued.)

TECHNICAL CHEMISTRY.

A Few Words on the So-called "Sombrero Guano," and some other Natural Phosphates, by Dr. PHIPSON, *F.C.S., &c.*

IN the last number of the CHEMICAL NEWS appeared an article (taken from the *American Journal of Science*, xxxvi.) on the so-called "Sombrero guano," in which the writer, Mr. Alexis Julien, endeavours, in a blundering manner, to criticise my opinion upon the nature of the mineral Sombrerite,* the essential part of this "Sombrero guano." It would appear that this gentleman, who styles himself "resident chemist at Sombrero," and assigns to bone phosphate the composition $3CaO,PhO_5$, whilst pretending that $2CaO,PhO_5$ can be washed off a filter with hot water, and that chloride of sodium is deliquescent, has not been able to ascertain the true composition of the rock on which he resides, and regrets that "Dr. Phipson does not inform us of the method used by him in his analysis." According to the "resident chemist," one-half of the cargoes exported from Sombrero contain 83 to 85 per cent. of bone phosphate of lime! We might add that the other half may then be supposed to consist of coral rock or carbonate of lime.

In making my analysis of Sombrero rock, I had merely in view the elucidation of its true composition. I was not prepossessed in favour of any "cargoes." The first sample I analysed was taken by myself from a hulk of some seventy tons, and the second from another hulk of about thirty tons. Since then several other samples have been forwarded to me for analysis. They all give very similar results, save when mixed with an undue proportion of carbonate of lime; and 65 per cent. of tribasic phosphate of lime, 17 per cent. of phosphate of alumina, with 4 to 5 per cent. of carbonate of lime, as in my published analysis, may be fairly taken as the average composition of the pure Sombrero phosphate.

I have designated this amorphous rock Sombrerite,† as it is the only natural example we have of a compound of phosphate of lime with phosphate of alumina.

The similarity of appearance between the madreporic rock (carbonate of lime) and the Sombrero phosphate does not allow them to be easily distinguished by persons unaccustomed to observe. Hence, it is not surprising that a considerable amount of this coral rock reaches England along with the phosphate. Its presence is, however, easily detected in the commercial world by a drop of muriatic acid, which causes immediate effervescence; and the few persons who purchase this rock phosphate here in London (paying for it about the same price as for the best description of bone ash) are well aware of this impurity. We cannot but suppose that the "resident chemist" is also aware of this admixture, and the effects it has upon the composition of "a well-chosen specimen," especially when such a mixture is imperfectly analysed, and the composition of bone phosphate written $3CaO,PhO_5$. At such a rate, we may, indeed, inform the public that Sombrero phosphate contains 83 to 85 per cent. of bone phosphate of lime, but with the risk of being exposed!

The late Mr. John Nesbit analysed four specimens of this Sombrero rock as early as 1858 (but did not recognise its atomic composition); these four specimens gave from 9 to 13 per cent. of oxides of iron and alumina; my analysis alluded to above shows 17 per cent. of phosphate of alumina, and yet Mr. Alexis Julien boldly asserts that this Sombrero phosphate contains "less than 1 per cent. of phosphate of alumina, and often none!"

The resident chemist at Sombrero regrets that I do not make known my method of analysis; I will state at once that it is to be found entire in the treatise of Fresenius, and recommend it to his particular attention.

As to the origin of Sombrero phosphate, it is evidently in no way connected with guano. I have shown elsewhere‡ that not a trace of uric acid can be discovered in it, nor do we find any compound of alumina in the ash of guano. Guano appears to split up naturally into two parts by gradual decomposition, the one consisting of bicarbonate of ammonia, which, according to my analysis of a specimen from the Chinca Isles, contains NH_4O, 29·76; CaO, 6·02; HO, 11·00; CO_2, 51·53; uric acid and alcalis, 1·09; phosphoric acid, 0·60, &c., = 100·; and the other, known as "West India phosphate," which gave me—Phosphate of lime, 35·5; carbonate of lime, 34·0; with 16·5 per cent. of organic matter, containing 0·46 of nitrogen, and in which I recognised a notable amount of the true Xanthic oxide, precipitable from its solution in soda by a current of carbonic acid.

As I am upon the subject of natural phosphates, I will state here that, besides the Cambridge and Suffolk coprolites so plentiful in England, the former of which, according to a great number of analyses made in my laboratory, contain on an average 65 per cent. of tribasic phosphate of lime, and the latter 56 per cent. of this phosphate, there exists also in the chalk districts of England, particularly those of the Isle of Wight, fossil wood and other petrified remains of sponges, polypes, &c., which contain a large amount of phosphates.§ The following is the analysis of a specimen of fossil wood of this description, forwarded to my laboratory about eighteen months ago. Its specific gravity was 2·71, its colour brown; it lay in the green sand of the Isle of

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* *Journ. of Chem. Soc.*, 1862, and CHEMICAL NEWS, vol. vi.

† *Loc. cit.*

‡ *Journ. of Chem. Soc.*, 1862, p. 277, and 1863, "On the Bicarb. of Ammonia of the Chinca Isles."

§ I believe Mr. Thomas Way was the first to call attention to them in 1848.

Wight, and showed here and there on the surface minute crystallisations of wavelite. It gave me in 100 parts—

Water	11·00
Organic matter	6·62
Lime	38·52
Magnesia	1·00
Oxides of iron and uranium . . .	2·13
Phosphoric acid	32·43
Fluorine	3·90
Chlorine } Sulphuric acid }	traces.
Sand, &c.	4·40
	100·00

The quantity of phosphoric acid in this fossil is nearly equivalent to 70 per cent. of tribasic phosphate of lime, and I am informed that considerable quantities of such fossils are to be found in the south of England. This composition approaches that of the Estramadura phosphate, or apatite, imported from Spain, the pure samples of which contain—

Tribasic phosphate of lime	92·00
Fluoride of calcium	8·00
	100·00

It results from the foregoing—

1st. That the so-called "Sombrero guano" is not a guano at all, nor has any relation to guano. That it is a distinct compound of phosphate of lime and phosphate of alumina, to which I have given the name of Sombrerite. That this Sombrerite forms the essential part of the Sombrero phosphate, and that this rock is frequently mixed accidentally or intentionally with a large amount of carbonate of lime.

2nd. That the richest of all mineral phosphates in phosphate of lime is the Estramadura phosphate from Spain, and that we have phosphates in England in abundance, the composition of some of which approaches that of the latter.

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL MEETING.

Wednesday, January 6, 1864.

G. W. Sandford, *Esq., President, in the Chair.*

The first paper read was "*On the Importation of the Root-Bark of Chinchona Calisaya from Bolivia,*" by John Eliot Howard, F.L.S. The author stated, that in recent importations of calisaya bark from Bolivia he had noticed the admixture, to a large extent, of the root bark, a specimen of which was before the meeting, and which presented sufficiently striking characteristics to distinguish it from the ordinary calisaya bark. Its curly form was its chief peculiarity. The probability of the root-bark finding its way into use in the manufacture of tinctures and decoctions, had induced him to examine it. The yield of a very favourable specimen of root-bark in purified alkaloids was 8·14 parts in 1000. Of this only 3·06 parts were obtained as a crystallised salt of quinine, the rest consisting almost entirely of the quinidine of Pasteur. Further investigation was demanded to account for the substitution of quinidine for quinine in the descent of the sap to the roots of the plant, and, if confirmed, would be somewhat curious. There was no doubt that the first formation of the alkaloids took place in the leaves, and it would be very interesting to know how, in the downward descent of the sap, such changes as the conversion of one alkaloid into another could take place. The collectors in Bolivia had succeeded in selling the root-bark as genuine calisaya, but the low estimation in which it was held in Europe had disappointed them.

Professor Bentley remarked that much importance was attached to Mr. Howard's paper. It showed that the proportion of quinine existing in the root-bark was very much less than that found in the ordinary calisaya bark of commerce. All purchasers of bark should be made aware of this, and be on their guard, so as not to be deceived into purchasing the root-bark for the true calisaya.

Mr. Hanbury said that the observations of Mr. Howard were parallel to those of M. De Vrij on the chinchona cultivation in Java, where he had proposed to extract the alkaloid from the root-bark, but had found the yield very poor.

Professor Redwood said there were other falsifications of calisaya bark even more important than that of the admixture of the root-bark, because they contained no quinine. His own opinion was, that calisaya bark did not contain the amount of quinine which had been ascribed to it. He was in the constant habit of analysing calisaya, but had never found the large proportion of quinine which had been stated to exist.

The next paper was "*On Goa Powder,*" by David S. Kemp, Bombay. The substance known as Goa powder was first introduced into Goa, on the Bombay coast, some twelve years since, by a Portugese merchant. It was in masses, mixed with fragments of root, stems, bark, and other matters. The masses were reduced to powder, and sold at Goa, from whence it found its way to Bombay. The importer afterwards removed to Mozambique, where he died, and it is believed that the manufacture of Goa powder is still carried on at that place. Goa powder is a light, chocolate-coloured powder, and is used very successfully in obstinate skin diseases, to which both Europeans and natives are subject. It is rubbed on the skin with water or lemon juice. From the analogy existing between the substances found in Goa powder by the author in his analyses, with erythroleic acid and azoerythrin—bodies obtained from orchella-weed—and from the fact, that large quantities of the orchella are exported from parts north of Mozambique, it is highly probable that the orchella-weed is a large constituent of Goa powder.

Dr. Attfield, having examined a specimen of Goa powder, furnished him by Mr. Hanbury, with whom the author had communicated, could fully confirm Mr. Kemp's diagnosis. From his examination of Goa powder, he was led to think that English cudbear was a good representative of it. The colorific matters contained in it confirmed this.

After this, a "*Note on the Recovery of Essential Oils from their Watery Solution,*" by T. B. Groves, was read. The author was led to the discovery of the process by the failure of the process of M. Piver, given in the "Reports of the Juries," 1851. The object was the concentration of an aromatic water into a spirituous essence. To the water was added about one-eighth of its volume of olive oil, which was emulsed by solution of potash. The emulsion was destroyed by the addition of an acid, when the olive oil immediately rose to the surface, bringing with it almost all the aroma. The aromatic oil was easily separated from the fatty oil by agitation with rectified spirit.

Thomson's Patent Bottles for the Prevention of Poisoning were exhibited, and the construction of them explained to the meeting. The chief feature consists of the substitution of a metal cap for the ordinary cork or stopper. To the cap is attached a small key, with which it may be locked, thus preventing access to poisons of persons not in possession of a key, and offering a peculiarity sufficiently obvious either to dispenser or patient to remind that the bottle contains a poison.

Mr. Thomson also laid before the meeting some of his *Patent Labels for the Prevention of Accidental Poisoning.* The preventive consists of a border of sand-paper round each label, thus appealing strongly to the sense of touch. It was applicable to dispensing bottles and to the smallest phials, and possessed an advantage over any form of bottle, inasmuch as the label could be applied to any vessel, while the chemist would often be compelled to put poisons into ordinary bottles for want of one of a particular shape being in stock.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

December 29, 1863.

E. W. Binney, *F.R.S., F.G.S., President, in the Chair.*

Mr. Sidebotham exhibited two photographs which he had taken from a book in the possession of Mr. Buxton, of Daresbury, entitled, "Histoire de la Navigation aux Indes Orientales, par les Hollandois," Amsterdam, 1609. One of these represents the title-page, which is interesting as showing, in the map of Africa which it contains, the course of the Nile and the two lakes from which it springs, one of them having two outlets. The other photograph shows, among figures of other productions of the Mauritius, that of the Dodo. It would appear that this is the earliest figure of this now extinct bird.

T. T. Wilkinson, F.R.A.S., communicated the following note on the late meteor:—On December 5, 1863, at about 7h. 55m. p.m., I observed a very brilliant meteor at Haslingden. It passed from the north towards the west, and was first visible to me when near to γ *Ursæ Majoris.* The nucleus was of an egg-like form, the head being intensely bright and considerably broader than the rest. The atmosphere was quite clear at the time, and hence I had a good view of its whole passage. Its colour was pale blue, and the light it emitted was so intense that the public gas lamps were immediately put into shade, and suddenly threw their shadows across the road. The tail of the meteor gradually tapered to a point, and appeared to give out sparks of a purplish tint. When about 4° beneath α *Lyræ*, the meteor exploded, and then the sparks were so variegated in colour—the red and purple tints prevailing—that they gave me the idea of a rocket, and I for a moment thought that the Haslingden people were doing this in honour of the Marquis of Hartington's visit to their town. This illusion was, however, immediately dispelled. The whole time of passage did not occupy more than a few seconds. Although several hundreds of persons witnessed the phenomenon, I cannot find that any one heard any sound made by the meteor either during its passage or on its explosion.

NOTICES OF BOOKS.

The Retrospect of Medicine: being a Half-Yearly Journal, containing a Retrospective View of every Discovery and Practical Improvement in the Medical Sciences. Edited by W. Braithwaite, M.D., &c., &c., and James Braithwaite, M.D. Vol. XLVIII., July to December, 1863. London: Simpkin, Marshall, and Co. 1864.

We can only notice the punctual appearance of this very useful compilation. With nothing of particular importance, it contains the usual amount of well-selected matter.

The Ghost! as Produced in the Spectre Drama; popularly Illustrating the Marvellous Optical Illusions obtained by the Apparatus called the Dircksian Phantasmagoria: being a full Account of its History, Construction, and Various Applications. By Henry Dircks, Civil Engineer, &c., &c., the Inventor. London: Spon and Co. 1863.

The title of the work well explains its contents, and the marvellous ghost need no longer be a mystery to any one who will read this little book. Everything relating to it is fully explained, and excellent suggestions are given for producing new illusions. We are sorry to say that there are, besides, a preface and an appendix, which are painful to read, on account of the personal dispute introduced.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(eighth notice.)

(Continued from Vol. VIII., page 299.)

We resume our notices of this deeply interesting Report, and come next to Phosphorus. This element is found in minute quantities almost everywhere in Nature. It is an essential constituent of fertile soils, and of all living organisms. But people have been rather puzzled to account for the mountains of apatite (crystalline phosphate of lime) which have already been found in one or two parts of Europe, and which may exist in other quarters of the globe. We quote the Reporter's explanation:—"Large masses of phosphorus are, in the course of geological revolutions extending over vast periods of time, restored from the organic reigns of Nature to the mineral kingdom by the slow process of fossilisation, whereby vegetal tissues are gradually transformed into peat, lignite, and coal; and animal tissues are petrified into coprolites, which, in course of time, yield crystalline apatite." And then:—"After lying locked up and motionless in these forms for indefinite periods, phosphorus, by further geological movements, becomes again exposed to its natural solvents, water and carbonic acid, and is thus restored to active service in the organisms of plants and the lower animals, through which it passes, to complete the mighty cycle of its movements, into the blood and tissue of the human frame. While circulating thus, age after age, through the three kingdoms of Nature, phosphorus is never for a moment free. It is throughout retained in combination with oxygen, and with the earthy or alkaline metals, for which its attraction is intense."

Free phosphorus has, however, become a necessity for civilized people, and it is now manufactured in enormous quantities by some modification of the following process devised by Nicolas and Pelletier. The principle of the method is the reduction of monobasic phosphate of lime by carbon. Bone ash (tricalcic phosphate) is treated with sulphuric acid, which abstracts part of the lime:

$$Ca_3PO_4 + H_2SO_4 = CaH_2PO_4 + Ca_2SO_4.$$

The acid solution of monocalcic phosphate is boiled down to a syrup, a small quantity of tricalcic phosphate which separates is removed, and the residue is heated to redness; the basic water of the acid phosphate escapes, and a residue of metaphosphate (monocalcic phosphate) remains. This salt is mixed with charcoal and exposed to a higher temperature, when a quantity of phosphoric acid is reduced to phosphorus as will reproduce tribasic phosphate:

$$3CaOPO_3 + C_5 = Ca_3PO_4 + 5CO + P_2.$$

The operation is generally carried on in the following manner:—

"The fresh bones are first freed from fat by boiling them in water, and skimming off the fat which floats upon the surface.

"The bones, thus freed from fat, are further treated in one or other of the following ways. In some cases the gelatinous matter is extracted by superheated steam, and the remaining earthy matter, after being dried and burnt, is used for the preparation of phosphorus. In other cases the bones are exhausted with dilute hydrochloric acid; the remaining cartilaginous substances used for the preparation of gelatine; and the acid solution of the bones precipitated with milk of lime, or better, with crude carbonate of ammonia. The tricalcic phosphate thus obtained, after being heated to low redness, is ready to be used for the preparation of phosphorus.

"Another process consists in subjecting the bones to destructive distillation, whereby ammonium salts and bone charcoal are obtained. The latter is either first used in the refining of sugar, or the crude bone charcoal is purified by exhausting it with hot hydrochloric acid, and the acid solution transformed as above into tricalcic phosphate."

Other processes have been proposed to obviate the necessity of treating the bones with sulphuric acid. One of these is that patented by M. Cary-Martrand. It is based on the following reaction:—When a mixture of bone phosphate and charcoal is exposed at a red heat to the action of hydrochloric acid gas, the whole of the phosphorus of the bones is set free, the reaction appearing to take place according to the equation—

$$Ca_3PO_4 + C_4 + 3HCl = 3CaCl + 4CO + H_3 + P.$$

The mechanical arrangements for conducting such a process can be readily devised.

Another process suggested by Fleck is the following:—The bones are treated with cold dilute hydrochloric acid; the solution is evaporated to sp. gr. 1·143. On cooling, this solution deposits crystals of acid phosphate of calcium: these are collected and freed from the mother liquor by pressure between porous stones. The white nacreous mass obtained is mixed with one-fourth its weight of wood charcoal, and distilled for the phosphorus. Neither of these two processes, the report says, has yet been brought into actual use.

Phosphorus, however obtained, requires purification, which is best effected by treating the crude product with sulphuric acid and chromate of potassium, as first suggested by Wöhler. A mixture of these two is added to a melted mass of crude phosphorus, whereby the red and brown products become oxidised, the impurities rising to the top in the form of a scum, while the pure, translucent phosphorus remains at the bottom of the vessel. Another method of purification, which consists in boiling the crude product with caustic potash, is said to yield a very pure article.

The largest amount of phosphorus is now produced in this country, but the Reporter is unable to give any data respecting the quantity. He states, however, that one French house—that of MM. Coignet, of Lyons—turns out 1680 cwts. per annum.

The process for manufacturing *amorphous phosphorus* is not described; but, as most of our readers know, it consists in exposing ordinary phosphorus to a high temperature for a considerable time. An uncertain amount of ordinary phosphorus is always left unconverted, on the complete removal of which the value of the new article entirely depends. This is effected by means of bisulphide of carbon, in which amorphous phosphorus is insoluble; but as it is extremely dangerous to employ large quantities of the bisulphide, the process of purification is carried on as follows:—The crude red phosphorus is only moistened with the bisulphide, and the mixture is then agitated with a solution of chloride of calcium, sp. gr. 1·26—1·38. Heat is afterwards applied, and the bisulphide of carbon, charged with the ordinary phosphorus, rises to the surface, from which it can be easily removed.

M. Coignet effects the purification by boiling with caustic soda ley, which dissolves ordinary phosphorus, converting it into hypophosphite of soda with the evolution of phosphuretted hydrogen. When the evolution of the latter ceases, the residual powder is washed and dried.

A good deal of interesting information respecting lucifer matches is given, but for this we have no space; but we cannot refrain from quoting the concluding paragraphs of this section—*On Lucifer Matches without Phosphorus.*

"The solution of this problem has been attempted by several eminent manufacturers, but their endeavours have not yet led to any satisfactory result.

"The very comprehensive and systematic labours of Wiederhold are beginning to throw more light upon this hitherto somewhat superficially treated branch of chemical technology. From his researches it appears that lucifer matches of good quality may be made with chlorate of potassium and hyposulphite of lead, a result which may prove most valuable should experience show it to be attainable on an industrial scale.

"The total elimination of phosphorus from the lucifer match manufacture would, indeed, be a grand achievement, not merely on sanitary grounds, or as diminishing fire risks, but also because it would liberate, for agricultural purposes, a large quantity of bones now consumed in the preparation of free phosphorus. No worthier object than this could engage the attention of an honourable class of manufacturers; and it is the Reporter's earnest hope that, before the Exhibition of 1872 shall have come round, *phosphorus* matches may be an obsolete appellation."

The Report next treats of several miscellaneous mineral products, an account of which we must postpone.

NOTICES OF PATENTS.

2330. *Improvements in the Manufacture of Ammonia and the Prussiates of Potash or Soda.* W. H. Hutchinson, Newton Heath, near Manchester. Dated August 20, 1862. (Not proceeded with.)

These improvements refer to the manufacture of ammonia and the prussiates of potash and soda from the refuse gluten and nitrogenous matters obtained in the preparation of starch. To obtain the first-named product, the gluten or other matters are submitted to destructive distillation in retorts, with lime, or soda and lime, the gaseous products being collected in suitable condensers. The crude liquor thus obtained may then be purified by neutralising with an acid, filtering the solution, and evaporating to crystallisation or by sublimation. The alkaline prussiates are obtained by fusing the gluten with potash or soda in an iron retort or open vessel. The fused mass is then lixiviated with water, filtered, and the solution crystallised by evaporation and cooling. Or, the prussiates may be obtained by passing the gaseous products disengaged, during the destructive distillation of the gluten, over a mixture of charcoal and potash, or soda, heated to redness in a second retort. The charcoal is then lixiviated as before, in order to furnish the prussiate. The second part of the invention refers to improvements in the apparatus for conducting these processes.

2346. *Soap Powder.* J. Mackay, Glasgow. Dated August 22, 1862.

The specification describes a mode of preparing a granular or crystalline powder, which is very efficacious for washing purposes. It consists of the following ingredients, viz.:—

Soda crystals	20 cwt.
Best pale yellow soap . .	1 ,,
Pearlashes	1 ,,
Black potashes	1 ,,
Soda ash	1 ,,
Sulphate of soda . . .	7 lbs.
Palm oil	7 ,,
Sulphuric acid	7 ,,
Chloride of lime . . .	7 ,,
Water	10 to 20 gallons.

These ingredients are all mixed together, and boiled for about five hours, either by a direct fire or by means of steam, after which the compound is run out into shallow troughs, and cooled with constant stirring.

A soap powder, composed merely of yellow soap and carbonate of soda in the proportions here specified, was known in commerce many years prior to the date of this patent.

2355. *Cleaning Organic Matter.* F. T. Moison, Paris. Dated August 23, 1862. (Not proceeded with.)

This invention consists in a mode of treating wool and other fibrous matters, when charged with oleaginous substances, with the object of separating the latter from the wool or other fibre. This is effected by volatile hydrocarbons, or the bisulphide of carbon, employed as solvents, which are by pressure forced through the wool or fabrics so as to dissolve and carry off the fatty matters, the liquid being afterwards submitted to distillation for the purpose of recovering the solvent for a new application, and for obtaining the fat in a separate form.

2371. *Manufacture of Paper and other Productions in which Fibrous Material is employed.* Henry Harben, Haverstock-hill, London. Dated August 27, 1862. (Not proceeded with.)

This proposal refers to the use of sea-weed, or other aquatic vegetable productions, in the preparation of pulp for paper-making. The weed is first washed in fresh water, and then bleached by treatment with liquid or gaseous chlorine, or a solution of chloride of lime; or, for the purpose of dissolving the colouring matter, steeped in dilute alcohol or wood-spirit. The material is then reduced to pulp by any one of the known processes.

In the *Times* newspaper, and subsequently at the Cambridge Meeting of the British Association, Mr. Harben advocated the policy of instituting a thorough investigation of the weed known under the name of "Zostera marina," the fibres of which, he believed, were capable of being used as a substitute for cotton. This proposal has not yet been turned to practical account in the manufacture of textile fabrics; but the application of such fibres to paper-making appears to have been attended with better success. This idea did not, however, originate with Mr. Harben, inasmuch as a patent for the same invention had already been granted, some fourteen months earlier, to M. Mennons, of Paris. The history of this and other claims referring to Zostera marina as a material for paper-making has been fully discussed at page 214 of our Sixth Volume.

2380. *Producing Light for the Various Purposes of Artificial Illumination.* W. E. Newton, Chancery Lane, London. Dated August 27, 1862.

This specification describes a new mode of producing the lime light, by the employment of jets of coal-gas or hydrogen in combination with others delivering a blast of atmospheric air which has been previously heated to such a degree as will make it serve like pure oxygen as a supporter of combustion. The compound flame is directed in the usual manner upon balls or cylinders of lime to produce a light of great intensity. A second claim refers to the utilisation of heated air in other instances of combustion, particularly in the case of lamps burning oil, or liquid hydrocarbons, and gas flames of every description, which thus become as intensely brilliant as the Bude light.

Much evidence could be adduced in favour of employing a heated current of air as a means of promoting the combustion of oils and fuels; its adaptation to these purposes is happily conceived, and likely to be successful. The principle of the hot blast in urging the combustion of the fuel and in raising the temperature of the furnaces has led to great results in the manufacture of iron.

2421. *Obtaining Light and Heat.* W. Clark, Chancery Lane, London. A communication. Dated September 1, 1862.

This invention refers to an improved method of lighting and heating by means of certain inflammable mixtures of air and vaporised hydrocarbons; also to apparatus suitable for the combustion of the said gaseous mixtures. The fuel employed consists of the following ingredients, viz.;—Benzol, 80 parts; ether, 10 parts; and powdered camphor, 10 parts. These are introduced into a closed vessel, provided with sponge or other absorbent material, and a current of air is then forced through this chamber, which on its escape may, by virtue of its impregnation with the vapour of these inflammable substances, be burnt at a jet exactly in the same manner as coal gas. When adapted to table lamps, the inventor employs a small fan, set in motion by clock-work, for the purpose of generating an air blast, or the heat caused by the combustion of the gas itself may be used as a means of establishing the necessary current of air. The apparatus may be of a diminutive character, and in this form can be applied to walking-canes, cigar-cases, &c. The inventor claims, likewise, the mode of combustion herein described as one suitable for employment with the lighter petroleum and coal oils.

For this last application there are other claimants who have devised as many different plans of impregnation, but all appear to be founded upon the same general principle.*

2426. *Manufacture of Muriate of Ammonia.* W. Hunt, Tipton. Dated September 2, 1862.

The inventor claims a novel mode of manufacturing chloride of ammonium, by passing a current of nitrogen gas or atmospheric air along with the vapour of hydrochloric acid through burning coal or coke; or, in a similar manner, through ignited fuel with which has been previously mixed one of the chlorides of iron or manganese, or any chloride which is capable of yielding chlorine or hydrochloric acid at that temperature.

It is known that small quantities of ammonia are generated whenever air and aqueous vapours are passed through a tube containing ignited coke or charcoal, and we have observed the formation of sal-ammoniac under circumstances in which common salt has been present. A sublimate of chloride of ammonium often collects in the interstices and upon the top of a stack of burning bricks, particularly at an early stage of the operation. With a different object, viz., the elimination of the sulphur, Professor Crace Calvert passes a current of hydrochloric acid vapour through burning coal during its conversion into coke. In some instances, chloride of sodium, instead of hydrochloric acid, has been employed for effecting the same purpose.

2446. *Manufacture of a Blue Colouring Matter.* W. Clark, Chancery Lane, London. A communication. Dated September 4, 1862.

For the production of this blue colouring matter the inventor mixes together equal parts by weight of magenta red and crystallised toluidine, and heats them to the temperature of about 300° Fahr. (or any point between 270° and 324° Fahr.) for a period of five or six hours. The product will consist mainly of the new colouring matter in a pasty condition mixed with the excess of toluidine, which it is advantageous to employ. By treating now with dilute hydrochloric acid (one part of acid to eight or ten parts of water), the whole of this latter basic substance may be dissolved, especially with the aid of heat, leaving the colouring matter in a state of purity, and fit for dyeing and printing when combined with suitable solvents.

The advantage of associating toluidine with aniline in the manufacture of this class of colouring matters was pointed out by Professor Hofmann (*vide* Chemical News, vol. viii., p. 4), and has been already alluded to in our remarks appended to Mr. Nicholson's patent.† It is, perhaps, an open question whether the prior claim of Messrs. Ingham and Wood ‡ includes the use of toluidine in the preparation of their blue colouring matter.

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* *Vide* Chemical News, vol. vii., p. 277.
† *Ibid.*, vol. vii., p. 219.
‡ *Ibid.*, vol. viii., p. 181.

2458. ***Manufacturing Gas for Illumination.*** S. H. **Hadley**, Upper Thames Street, London. Dated September 5, 1862.

This claim refers to the production of illuminating gas by passing steam and vaporised hydrocarbons over coke or other carbonaceous fuel heated to redness. A similar mode of proceeding will be found described at page 228 of our eighth volume.

Grants of Provisional Protection for Six Months.

2947. Thomas Carr, New Ferry, near Birkenhead, Cheshire, "Improvements in machinery for amalgamating or intermixing dry, semi-fluid, or aqueous materials, and for agitating solids with liquids for combining, dissolving, or washing the same."—Petitions recorded November 23, 1863.

2949. George Wagstaff Yapp, Clement's Inn, Westminster, "Improvements in the preservation of animal substances."—A communication from Edouard Gorges, Croisic, France.

2954. George Davies, Serle Street, Lincoln's Inn, London, "Improvements in photography."—A communication from Matthieu Risler, jun., Paris.

2959. William Edward Newton, Chancery Lane, London, "Improvements in balloons or aeronautic apparatus."—A communication from Eugene Godard, Rue St. Sebastien, Paris.

2963. George Parkin, Tryddyn, Flintshire, "Improvements in apparatus employed in the manufacture of paraffin and other like oils from shale, cannel, and other minerals."

2967. Louis Accarain, Chancery Lane, London, "Improvements in the manufacture of paper, thread, cordage, and fabrics from beetroot."

2971. Richard Laming, Priory Road, Kilburn, West Hampstead, Middlesex, "Improvements in preparing materials useful in the purifying of gas from sulphuretted hydrogen, carbonic acid, and ammonia, and in making ammoniacal compounds."

2974. James Baker, Temple Street, Whitefriars, London, "Improvements in compositions applicable to the coating of ships' bottoms."

2980. Thomas Gray, Mitcham, Surrey, "A new method of discharging colour from rags used for paper making or other purposes, and in treating of vegetable fibres by such process."

2981. Frederic Page, Birmingham, "Improvements in furnaces and apparatus for the manufacture of volatile hydrocarbons, which improvements are also in part applicable to furnaces and apparatus for the manufacture of illuminating gas."

2987. Heinrich Hirzel, Terminus Hotel, London Bridge, Southwark, Surrey, "Improvements in extracting essences and perfumes, and also oils and fats, from matters containing them, also in bleaching and purifying oils and fats, and in apparatus employed therein."

2988. Samuel Smith and Thomas Smith, Fell Street, London, "Improvements in composition or means for the purpose of destroying insects by fumigation, and in means or apparatus to be employed therewith."

3009. Benjamin Jones, Warrington, Lancashire, "Improvements in separating sulphur from alkali waste."

3012. Jesse Gustavus Redman and George Martin, Brompton, Kent, "Improvements in compounds or compositions for coating or covering iron or wooden ships and vessels, metallic sheathing, telegraph cables, and other objects, to preserve them from decay, fouling, or other destructive action."

3017. George Glover, Ranelagh Works, Ranelagh Road, Pimlico, London, "Improvements in dry gas-meters."

3018. James Thom, Hull, "Improvements in apparatus to be employed in expressing oils and fatty matters."

3023. William Wilson, Manchester, "Improvements in generating gas for illuminating and other purposes, when made by passing atmospheric air over or through volatile oils, and treating such gas and the gas made from coal or cannel after leaving the generators, so as to improve the heating and illuminating qualities thereof, and in the apparatus for effecting the same."

Notices to Proceed.

1882. Edwin Sturge, Walworth, Surrey, "Improvements in coating or protecting metallic surfaces." Petitions recorded July 29, 1863.

1902. Richard Archibald Brooman, Fleet Street, London, "Improvements in dyeing mixed animal and vegetable fibres, whether in a raw or manufactured state." A communication from Theophile Grison, Deville le Rouen, France.

1921. George Stevens, Malvern Cottages, Portland Place North, Clapham Road, Surrey, "Improvements in means or apparatus for effecting a regular supply of air or aeriform fluids for various purposes."

2731. Jean Augustin Barral and Louis Adolphe Cochery, Rue de la Fidelité, Paris, "Certain improvements in the manufacture of manure." Petition recorded November 4, 1863.

2888. William Wigfall and Gottlieb Jolly, Sheffield, "An improved explosive compound to be used in the manufacture of cartridges, and an improved mode of manufacturing cartridges therewith." Petition recorded November 18, 1863.

1941. James Young, Bucklersbury, London, "Improvements in the preservation of animal matter."

1947. Thomas Simmelklar, Blackrock, Cork, Ireland, and John Ibbetson Spicer, Park Road, Old Ford, Middlesex, "An improved composition for coating or painting the bottoms of ships or vessels, to prevent them from fouling,"—Petitions recorded August 6, 1863.

1952. John William Slater, Huddersfield, Yorkshire, "Improvements in the production of yellow and orange colouring matters."

2045. Joseph Arthur, Robert Terrace, Chelsea, Middlesex, "An improved apparatus for the prevention, cure, and relief of hernia of every description, together with prolapsus uteri, uterine hæmorrhage, hernia humoralis, and as a general support for enlargement of the abdomen from whatever cause proceeding."

2053. Richard Archibald Brooman, Fleet Street, London, "An improved method of, and apparatus for, treating molasses, syrups, saccharine juices, and other products." —A communication from Auguste Pierre Dubrunfaut, Bercy, France.—Petition recorded August 18, 1863.

2214. Joseph Lillie and John Haines Waite, Manchester, "An improved composition or coating for the protection and preservation of surfaces of iron, wood, and other materials."—Petition recorded September 9, 1863.

2760. William Daniel Allen, Laithfield House, Norfolk Road, Sheffield, Yorkshire, "Improvements in casting ingots of steel."—Petition recorded November 6, 1863.

2941. James Steart, St. James's Road, Bermondsey, Surrey, "Extracting the fibre from zostera marina and other aquatic vegetable productions."—Petition recorded November 21, 1863.

2967. Louis Accarain, Chancery Lane, London, "Improvements in the manufacture of paper, thread, cordage, and fabrics from beetroot."—Petition recorded November 25, 1863.

2029. Thomas Brooks, Wild's Rents, Long Lane, Bermondsey, Surrey, "Improvements in means or apparatus for the production of charcoal and other products from refuse tan and other woody substances."

2892. Edward Chambers Nicholson, Fenchurch Street, London, "Improvements in the manufacture of colouring matters suitable for dyeing and printing."—Petition recorded November 18, 1863.

CORRESPONDENCE.

Oxalate of Thallium.

To the Editor of the Chemical News.

Sir,—In the Chemical News of January 2, 1864, you state that, in my paper on "Organic Salts of Thallium," I attribute to the neutral oxalate the certainly extremely improbable formula C_4TlO_8. The formula C_4HTlO_8, given for the acid oxalate in one of the following paragraphs, sufficiently indicates that it is an error of the press, and not an error of the analyst, to which the inaccurate formula for the neutral salts has to be attributed. The publication from which you quote is the *Comptes-Rendus*. In the paper printed in the "Mémoires de la Société des Sciences de Lille," which I beg to transmit to you, the formula is printed correctly. I am, &c.

C. F. Kuhlmann, Jun.

The Patent Laws.

To the Editor of the Chemical News.

Sir,—Your correspondent, "Anti-Schemer," seems to be rather astonished at my statement of a simple fact, viz., that "the burglar, the pickpocket, the area sneak, &c.," make precisely the same objections to the laws which protect physical property as certain enterprising men in other trades make to the laws which protect the property of the inventor—that both suffer the same kind of inconvenience from these laws respectively. Upon these very simple and undeniable facts I based a very simple argument, viz., that the laws for the protection of physical property having been found beneficial to society in general by supplying men with a motive to physical industry and economy, and thereby adding to the general wealth of the community, we pay no attention to any suggestions that the burglars, pickpockets, area sneaks, &c., or their friends may make for the abolition of the property laws. In this case, as in many others, we sink the special interests of a particular class in favour of the general interests of the whole community. This being admitted, as it must be, I apply precisely the same principle to the other case, and say, that the laws for the protection of intellectual property having been found of vast benefit to mankind by stimulating ingenious men to make useful inventions and communicate these inventions to their fellow-men, we should pay no attention to the complaints of those other enterprising men who find the patent laws stand in their way, by preventing them from reaping the fruits of another man's labour without paying him for it.

As to the further question of the moral analogy or identity between the two classes of complainants I say nothing, but leave it for "Anti-Schemer" and his conscience to work out as they may.

"Anti-Schemer" illustrates the working of what he calls an absurd law by his own case. He has a tract of land containing certain minerals, and he "learns" that there are two ways of boring to his shale, or whatever it may be—a quick way and a slow way—but the quick, or improved, method is patented by the inventor. He has no objection to use another man's invention—he is very anxious to do so, but he objects to pay him for the use of it. He confesses that he himself will be a great gainer by using the process which he has learned from the inventor, but he thinks it a most absurd law that gives the discoverer and teacher any property in the knowledge created by his own intellect. His disgust is still greater when he proposes to use another man's brains for a method of bringing his mineral to the surface: "A patentee steps in, and says, 'You shall not use my invention without paying me.' Now, surely there was never such an absurd law as this. Was there ever anything so un-English as a law to prevent a man from doing what he likes with his own?" asks indignant "Anti-Schemer." I will answer his question by telling him that there was ever something of this un-English kind in England from the first dawnings of its civilisation, and there ever will be such things in this and every other country as long as its civilisation remains. There was and is a law which prevents the burglar from doing what he likes with his own crowbar, and the pickpocket and area-sneak from doing what they like with their own fingers, when they would like to use that crowbar or those fingers for taking away, without leave or compensation, the fair fruits of another man's skill and industry, or that which his own or his forefather's skill and industry have enabled him to purchase.

For the sake of argument, I have supposed that the mineral belonging to "Anti-Schemer" is a bituminous shale. Now, I happen to have some retorts made expressly for the distillation of such minerals, and I am quite as anxious to get some such mineral to put into these retorts as "Anti-Schemer" is to get his minerals out of the ground; but "Anti-Schemer" and other mineral proprietors "step in," and say, "You shall not use my mineral without paying me." Would "Anti-Schemer" treat me with much respect if I denounced as "absurd" the law which gives him the right to withhold the use of his minerals without payment, and if I insisted upon doing as I liked with my own (retorts), by using his mineral for the filling of them without pay or permission? I can venture to answer for him that he would not; for the whole tone of his letter shows that he has ample respect for his own property, and a full consciousness of his own rights as a proprietor.

He asks, "Is there any relation between the fancies of a schemer's brain and a man's purse?" To such as "Anti-Schemer," there may seem but very little, for he obviously worships the purse, and, by his flippant words, "fancies," and "schemer," he shows that he has but small ability to appreciate the dignity of intellect.

The patent laws do not protect any man's "fancies." Nothing is protected which is not completely and demonstrably practical and useful, and nothing else requires protection. No one can patent a theory, or an abstract or general principle;—nothing but a specific contrivance for a clearly-defined useful purpose. He must prove himself a practical benefactor to his fellow men, in order that his patent shall be valid. Foolish people patent foolish fancies, but they acquire no property in such fancies, and are merely fined for their foolishness in the form of a heavy contribution to the revenue through the Stamp Office, so that we get something even out of these.

But to return to "Anti-Schemer's" question, or rather what he evidently means by the question, viz., "Is there any relation between a patentable invention and a purse?" or, in other words, "Is a man's own invention his own property in the same sense as his land, his purse, or other physical wealth?"

My reply to this is, that it is the same in kind, but very different in degree, inasmuch as the proprietary right to an invention is far stronger that to any physical property; and more especially does this superior strength appear when we compare it with such property as "Anti-Schemer's" "*own*" minerals.

Who made those minerals? Certainly not "Anti-Schemer." Neither did the man from whom he may have bought the land, or his fathers from whom he may have inherited it. Nor can he show any sort of link between himself and those minerals that proves that his and the minerals' Creator made them for him rather than for me, or you, or any other man. The existence of those minerals are utterly and absolutely independent of the existence of "Anti-Schemer." Though "Anti-Schemer" had never been born, those minerals would have existed nevertheless. His rights are purely artificial; man's laws alone have made them his.

But how stands the proprietary relation between the inventor and his invention? He made it, and it is his; without him it was not, and but for him it would not be.

The faculties that immediately created it were given to him by his Creator—by the Creator of all things; he was the appointed agent for that particular work; it was his work, and—subject to the Power that holds all—it is his property. None of your parchments can show a title such as this.

So much for the abstract moral right. Now, let us consider it as a question of legislative policy. Our laws wisely decree that every man shall be protected in the fullest practicable enjoyment of what he has acquired, or his forefathers have acquired for him, whether that be property in money, houses, land, or otherwise; and, with equal wisdom, the law does not go too far back in its inquiries as to the original mode of acquisition, lest it should give rise to vexatious squabblings, and a general insecurity of property, especially of property in land. The politic basis of all this is, that men shall be encouraged in enriching the community by their efforts to acquire wealth for themselves, which efforts they obviously would not make, unless they were secured the peaceable enjoyment of it. Or, to summarise the matter, we may say that society protects the property of individuals, in order to enrich itself.

Now, let us compare such property as the minerals of "Anti-Schemer" with such as the invention of the inventor from this, the politic point of view. Which will afford society the largest gain in return for its protection?

At the outset, then, the minerals are there, whatever society may do, or fail to do, in the way of protecting "Anti-Schemer's" interest in them. Not so with the invention. Its very existence is, in most instances, utterly dependent upon its becoming a protected property. Take the great inventions of James Watt as an example. Without the patent laws they would have been impossible. They cost thousands of pounds, as well as a lifetime in the perfecting of them. Watt had not the means to construct the models and make the experiments, even if he had been foolish enough to devote his life to working for a community that was not honest enough to pay him for his work. Boulton supplied him with the means only because he had a prospect of large profit from holding a share in the patent rights. Let any one calculate how much was gained by Boulton and Watt (well paid as they both deservedly were), and compare that amount with the vast wealth that those inventions have yielded to Britain and to all mankind, and then let him say that the law which, by protecting, created such inventions, was not a good national investment. The history of every other great practical invention, or series of inventions, is but a modified repetition of the same tale. Before the patent laws existed, the very few inventions then made were held by their inventors as secrets; and, from the fear of divulging them, they were not half worked during the inventor's lifetime, and then lost entirely on his death.

If we go a little further, we shall see how the laws for the protection of property prove to be wise laws, even in the case of mineral property, such as "Anti-Schemer's;" for, though the property laws, applied to minerals, could not bring the minerals into existence, as in the case of inventions, they can and do bring them to the surface; for if "Anti-Schemer" were not protected by the law in the proprietorship of these minerals, he would not be so foolish as to spend his money and his labour in boring, sinking, driving, pumping, and raising. No just and reasonable man denies or envies "Anti-Schemer" the possession of all the profits he can fairly gain by his mining efforts, for we are all partners in his profits, inasmuch as he adds to the world's wealth by rendering the hidden treasures of the earth available to man's use; and "Anti-Schemer" should be the last of all men to envy or grudge the inventor his little share, in the form of royalty, when that inventor has, as he confesses, made his task so much easier, so much more rapid, or even, as he intimates, made all the difference between rendering the raising of these minerals a matter of profit or no profit. To say that the inventors of the improved processes for boring and raising stand in his way is simply ridiculous. Had they never existed, he must have used the old way. As it is, he has a choice between that and their inventions. If they ask for the use of their inventions more than their inventions are worth, he is at liberty to do without them; if not, he clearly gains by their inventions, even after paying for them. He talks as though the patent laws were laws for forcing him to use new inventions and to pay royalties upon them.

The wild communists who raised the cry that "property is theft," were marvellously stupid and not particularly just. Those who are now feebly attempting to raise a crusade against inventors' property are equally shallow and still more unjust; for the communists did propose to rob all alike, while the anti-patent people propose to rob only one class with the supposed object of enriching one other by the spoil. Doubtless the patent laws are defective and improvable; but if we are to abolish all laws that are not perfect, we must return to a state of very primitive simplicity.

I am, &c.

W. Mattieu Williams.

Oak Alyn, near Wrexham, January 9, 1864.

MISCELLANEOUS.

THE BATTLE OF THE CHLORODYNES.

Vice-Chancellor's Court, Jan. 11.

(*Before Vice-Chancellor* Sir W. P. Wood.)

BROWNE *v.* FREEMAN.

Mr. Giffard, Q.C., and Mr. Fischer moved for an injunction to restrain the defendant from selling any medicine, not being chlorodyne of the plaintiff's manufacture, under the name of "The Original Chlorodyne," or under any other name so contrived as by colourable imitation or otherwise to represent the article to be chlorodyne manufactured by the plaintiff.

The case made by the bill was that the plaintiff, Dr. John Collis Browne, while serving as an assistant-surgeon with the Queen's army in India, invented, about 1846, an entirely new medicine, which, as he stated, was used with great success in cases of fever, dysentery, cholera, and other diseases incident to an Asiatic climate. The term "chlorodyne," which was invented by the plaintiff, not by way of explaining the composition or properties of the compound, but as a fancy name to be used as a trade mark, was first applied by him to his medicine in 1855, and under this title the compound became widely known, and appears to have acquired great reputation. In 1858, the plaintiff being desirous of securing the exclusive right to use the word "chlorodyne," registered at Stationers'-hall a label headed—"Dr. J. Collis Browne's Chlorodyne," and also containing the words, "the only genuine chlorodyne." In October, 1861, the attention of the plaintiff was called to a circular issued by the defendant Freeman, who describes himself as a "Pharmaceutist," in the Kennington-road, to the effect that he had "for several years made and used extensively in his business an article which had lately been named 'chlorodyne,'" and had determined to prepare it on a larger scale than heretofore, and introduce it to the medical profession, &c. In May, 1862, the plaintiff filed a bill against the defendant to restrain him from using the term "chlorodyne," but being advised that it was doubtful if he could prevent the defendant from selling his medicine as "Freeman's Chlorodyne," obtained an order in November, 1862, dismissing that bill with costs.

The defendant had latterly, however, advertised himself as the first inventor, in 1844, of chlorodyne, and advertised his medicine as "The Original Chlorodyne," appending a statement to the effect, that it was proved by the increasing demand in the profession to be "a superior and more reliable preparation than any which has been produced by other makers," and adducing medical testimonials to its invaluable qualities, and that it was "quite as efficacious in all cases as the medicine known as 'Collis Browne's Chlorodyne.'" The plaintiff had thereupon filed the present bill to restrain the use of the term "Original Chlorodyne" by the defendant, as being calculated to mislead the public into the belief that his medicine was that of the plaintiff, and fraudulently to injure its sale and reputation. Evidence in support of the plaintiff's case had been given by physicians, druggists, &c., to the effect, that the plaintiff's medicine was generally known in the profession as chlorodyne simply, and that when chlorodyne was prescribed the plaintiff's medicine would be alone intended. The name was also stated to be merely fanciful; and one of the witnesses, a physician of eminence, when the compound was first brought to his attention, actually protested against the name as absurd and preposterous, meaning, if anything at all, "green pain," and begged the plaintiff "not to strangle" his medicine by sending it out into the world under such a title.

The defendant's case was, in substance, that the ingredients of the medicine sold by him as chlorodyne were known to him as long ago as 1844, and that the term was not one in which a trade mark could be claimed, as it expressed the character and main ingredients (chloroform and anodynes) of the composition. The defendant also stated that he had carefully distinguished the chlorodyne sold by him by attaching his own name, and using a different label and advertisement from that of the plaintiff; and that, although he had used the compound from 1844 to 1859 as a remedy, he had not advertised it or sold it to any extent before the latter year, as he did not till then fully appreciate its value. In reference to his use of the term "Original Chlorodyne," which had led to the present suit, he stated his belief that he was, in fact, the first inventor and discoverer of it, but denied any intention to represent that his compound was that of the plaintiff. Evidence of physicians and others was also adduced for the purpose of showing that the name would be understood as denoting the qualities of the composition, and not as a special title or trade mark to which the plaintiff was alone entitled, and that it was usual in prescriptions to specify what chlorodyne, whether Browne's or Freeman's, was to be supplied.

The Vice-Chancellor said that the case was one of very grave suspicion, but he doubted whether it was sufficiently made out so as to enable him to do anything until the hearing of the cause. The plaintiff had placed himself in a difficulty by abandoning the first suit that he had instituted, and getting the bill dismissed with costs. It was by no means clear that the term "chlorodyne" was not one of so fanciful and whimsical a nature as to be original, and to entitle the plaintiff to its exclusive use. There was strong evidence that persons asking for chlorodyne alone would be supplied with that manufactured by the plaintiff; but then there was also other chlorodyne in the market, and a careful shopman would ask the customer which he wanted—whether Browne's or Freeman's. Although it was so far favourable to the defendant that the word "Original" did not appear upon the outside of the wrapper, still he had by no means justified the use of the term. Chlorodyne *simpliciter* would mean that made by the plaintiff, and for this reason, that it was known in the market under that title before the defendant had ever thought of using the word. *A fortiori*, therefore, when the term "Original" was applied to the article, people would think that it must mean that which was manufactured by the plaintiff. The successive alterations in the advertisements led to a very strong suspicion that there had been a gradual course of proceeding for the purpose of getting the name "Original" attached to the defendant's medicine, and thus misleading people into the belief that they were buying that of the plaintiff. But it was not shown that any one had been deceived by the label of the defendant, or that any one had asked for "Original Chlorodyne," and been misled into the belief that he was purchasing that of the plaintiff. If the defendant advertised himself as the original inventor, people who asked for "Browne's Chlorodyne" were not necessarily deceived, as the defendant simply said that his medicine was better than Browne's. That was a question, however, with which he could not deal; although if it had been shown that any one had been deceived, there was enough on the bill to sustain the injunction: he was not justified in summarily interfering as the case now stood. The motion would stand over until the hearing; and if the bill were dismissed in the meantime, the costs would be costs in the cause.

Royal Institution.—Tuesday, January 26, three o'clock, Professor Tyndall, F.R.S., "On Experimental Optics." Thursday, January 28, three o'clock, Professor Tyndall, F.R.S., "On Experimental Optics." Friday, January 29, eight o'clock, W. R. Grove, Esq., Q.C., "On Boiling Water." Saturday, January 30, three o'clock, John Lubbock, Esq., F.R.S., "On the Antiquity of Man."

Royal Institution of Great Britain.—Probable arrangements for the Friday evening meetings before Easter, 1864;—

January 22. W. R. Grove, Esq., Q.C., F.R.S., "On Boiling Water."

January 29. Professor Frankland, F.R.S, "On the Glacial Epoch."

February 5. J. A. Froude, Esq., M.A., "On the Science of History."

February 12. Professor Wanklyn, "On the Synthesis of Organic Bodies."

February 19. W. S. Savory, Esq., F.R.S., "On Dreaming and Somnambulism, in their relation to the Functions of certain Nerve-centres."

February 26. J. Prestwich, Esq., F.R.S., "On the Quaternary Flint Implements of Ahheville, Amiens, Hoxne, &c., their Geological Position and History."

March 4. Professor Stokes, Sec. R. S., "On the Discrimination of Organic Bodies by their Optical Properties."

March 11. The Rev. W. H. Brookfield, M.A., "On the Use of Books."

March 18. Professor Tyndall, F.R.S.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following papers will be read: "Absorption of Mixed Gas in Water." By W. M. Watts, Esq. "On Urochrome." By Dr. Thndichum.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

M. B.—Apply to the Secretary of the Society.

W. B.—The process is not yet published.

Photo.—There is but one mode, that given in chemical books, which is carried out on a large scale, with no peculiar arrangements.

Received.—M. de La Peyrouse, next week; A. Guyard.

H. H.—The simplest way of analysing blue pill is to boil with hydrochloric acid, and precipitate the mercury with protochloride of tin.

Reader.—The separation has been attempted by placing the substance in contact with finely-divided silver, and heating the mixture. It must be done, with precaution, in a closed tube.

Chlorine.—There is no work which treats of the manufacture on a large scale. The process given in the Pharmacopœia may be conducted, with care, on a considerable scale.

Books Received.—Chemistry, Chambers' Educational Course; Galloway's Second Step in Chemistry.

THE BRITISH PHARMACOPŒIA.

The Pharmacopœia is now completed and printed, and the issue is only delayed until enough copies have been bound to supply at once the immediate demand. We have for some weeks been in possession of the principal novelties in the work, but have refrained from printing them until the work was really published. But as parts have now found their way into the professional prints, and as we are told that at some establishments the new preparations are all made, and bottles labelled ready to place on the shelves the moment it is telegraphed that the Pharmacopœia is out, we need no longer observe any delicacy.

The great delay in the publication of the work is ascribed in the Preface to the following causes:—

"Numerous researches in chemistry, pharmacy, and natural history, and into the value of old and new remedies, carried on with the complex machinery of a Committee in each of the three divisions of the kingdom, necessarily occupied much time. To these, the principal causes of delay, were added difficulties arising from the present state of the law of copyright, which obliged the Council to apply to the Legislature for an Act of Parliament to enable them to give authority to the British Pharmacopœia, and to secure a title in the copyright. Further delay was subsequently occasioned by the necessity of altering, in deference to the general wish of the medical profession, the pharmaceutic weights which the Committee had previously adopted in the composition of the work."

This statement, while fully accounting for the delay, hardly explains the cost of the book, which is set down by a contemporary at 6000*l.*, but which, we are informed, will more probably amount to 8000*l.* That matter, however, only concerns the profession whose money the Council spends.

The book will be issued in two forms—one at 10s. 6d., the other at 6s. At present, we see no other edition announced, but, no doubt, several will be published, with useful annotations, within a short time of the first issue. The Medical Council, as we have seen, succeeded in obtaining an Act of Parliament to secure them a copyright in the bare work; but there will, of course, be no difficulty in constructing a book to which that Act cannot possibly apply. There are, indeed, grave doubts whether such a thing as a copyright can exist in any work, such as a pharmacopœia or an Act of Parliament, which is binding on any section of the community. There is no necessity, however, for any enterprising author to try the question. Notes and omissions make an entirely new book.

While at this point, we may as well explain the plan we intend to follow in the remarks we shall proceed to make on the work. In the present number we have given a list of most of the new preparations, and of the alterations of names from the last London Pharmacopœia. In our next notices we shall give a detailed account of the novelties introduced. We shall then proceed to notice the new methods and processes which have been given for preparations under the old names, and also the differences of strength which have been made in some preparations. The following extract from the Preface to the Pharmacopœia, will show that some of these are important:—

"Thirdly, an attempt has been made to assimilate the strength of preparations of the same pharmaceutic form, in order that they may be prescribed in similar doses. The Council regret that difficulties of detail have hindered their Committee from carrying out this principle systematically, because uniformity of medicinal strength in preparations of similar form would be a great safeguard against dangerous mistakes, as well as a great facility alike to the prescriber and dispenser. Nevertheless, the contemplated improvement has been effected extensively, especially in the preparations where it was most required. Thus, among the tinctures, those made with dangerous ingredients are, with few exceptions, brought to one standard of strength, so that an ordinary dose is from fifteen to twenty-five minims; while all tinctures made with substances of no great activity are left, as formerly, uniform in strength, so that an ordinary dose is from one to two fluid drachms."

Uniformity of dose will undoubtedly be a safeguard for prescribers with short memories, but we do not see how it will facilitate dispensing. Nevertheless, we regard the change as a decided improvement.

From what we have said above, it will be seen that our notices will contain an epitome of all that is new in the book; and, considering the importance of the matter to a large section of our readers, we shall proceed with these notices as early as possible.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Solubility of Some Thallium Salts,

by William Crookes, *F.R.S.*

The following table is the result of many careful experiments. The figures may be relied upon as accurate:—

One part of Thallium		Water at 60° F.	Boiling water.
Protochloride	dissolves in	283·4 parts.	52·5 parts.
Sesquichloride	,,	380·1 ,,	52·9 ,,
Iodide	,,	4453·0 ,,	842·4 ,,
Platinochloride ...	,,	15585·0 ,,	1948·0 ,,
Sulphate	,,	21·1 ,,	5·4 ,,
Nitrate	,,	9·4 ,,	— ,,
Carbonate ...	,,	24·8 ,,	3·6 ,,
Oxalate	,,	69·3 ,,	11·0 ,,
Binoxalate ...	,,	18·7 ,,	— ,,
Phosphate ...	,,	201·2 ,,	149·0 ,,
Terchromate ...	,,	2814·0 ,,	438·7 ,,

The nitrate and binoxalate dissolve in considerably less than their own bulk of boiling water, forming a syrupy solution.

The insolubility of the platinochloride is remarkable. It may be of interest to compare it with the corresponding potassium, ammonium, rubidium, and cæsium salts:—

One part of Platinochloride of		Water at 60° F.	Boiling water.
Potassium	dissolves in	108· parts.	19· parts.
Ammonium	,,	150· ,,	80· ,,
Rubidium ...	,,	740· ,,	157· ,,
Cæsium ...	,,	1308· ,,	261· ,,
Thallium ...	,,	15585· ,,	1948· ,,

Researches on Quinoline, by M. Hugo Schiff.

Quinoline combines with metallic salts, and furnishes compounds similar to anilometallic combinations.

If we admit the presence of a triatomic radical $\mathrm{C}_9'''\mathrm{H}_7$, in quinoline $\mathrm{C}_9\mathrm{H}_7\mathrm{N}$, the general formula of monometallo-quinic compounds will be—

$$\mathrm{N}\left\{\begin{matrix}\mathrm{C}_9'''\mathrm{H}_7\\ \mathrm{M}\end{matrix}\right\}\mathrm{X}=\mathrm{C}_9\mathrm{H}_7\mathrm{N},\mathrm{MX},$$

in which X represents an acid radical. For the most part, these compounds are crystallised, and slightly soluble in cold water. Prolonged boiling is necessary to decompose them. Exposed to air and sun, they become slightly yellow. Combinations with tri and tetratomic metals are obtained with difficulty, and decompose easily.

Hydrochlorate of zinco-quinoline—

$$N\left\{\begin{matrix}C_9{}'''H_7\\ Zn\end{matrix}\right\}Cl = C_9H_7N,ZnCl,$$

is prepared by direct addition, and crystallises from the hot solution in small and apparently monoclinic prisms. We have, besides, obtained the hydrobromate and hydriodate. Cadmium forms perfectly analogous combinations.

With nitrate of mercury, quinoline gives a white precipitate, nitrate of mercuro-quinoline,—

$$N\left\{\begin{matrix}C_9H_7\\ Hg\end{matrix}\right\}N\Theta_3$$

little soluble in pure water, but much more so in boiling water, with a little nitric acid. This solution deposits the crystalline salt without decomposing it. Prolonged boiling transforms the salt into polymercuro-quinolic compounds. Potash colours it yellow; and it becomes brown when heated. The salt is transformed into a viscous mass, while part of the quinoline volatilises with the aqueous vapour. The nitrate of mercuro-quinoline assists in the double decomposition with the alkaline salts; but the reaction is more precise if the acetate is used. A solution of acetate, heated with the alkaline salts, gives, on cooling, the crystalline salts of different acids. By this method I have obtained hydro-chlorate, -bromate, and -iodate, sulphate, and chromate of mercuro-quinoline. All these salts are easily decomposed by raising the temperature. The yellow chromate is transformed at 100° into a viscous mass.

Hydrocyanate of mercuro-quinoline,—

$$N\left\{\begin{matrix}C_9H_7\\ Hg\end{matrix}\right\}Cy = C_9H_7N,CHgN,$$

obtained by direct addition, crystallises, from its aqueous solution, in long brilliant prisms. This compound is attended by none of the phenomena of dissociation belonging to hydrocyanate of mercuraniline.

Bichloride of tin, as also the trichlorides of bismuth, antimony, and arsenic, combine directly with quinoline; but these combinations do not possess the remarkable stability of corresponding combinations of aniline.

Towards acids, metallo quinolic compounds behave like metallanilides. With the exception of mercuro-quinoline, the salts furnish, by decomposition, double compounds, well crystallised and soluble, without decomposition, in acidulated water. The composition of these double salts is not analogous to that of double salts of aniline. While the latter always contain a number of equivalents of aniline equal to the atomicity of the metal, the number of equivalents of the base in double salts of quinoline is often less than that of the atomicity of the metal. We will quote only the following formulas of double chlorides:—

Zinco-quinolic chloride .	. $ZnCl,C_9H_8NCl$.
Stibio-quinolic chloride .	. $SbCl_3,C_9H_8NCl$.
Stanno-quinolic chloride .	. $SnCl_2 2C_9H_8NCl$.
Bismo-quinolic chloride .	. $BiCl_3 3C_9H_8NCl$.

Quinoline becomes red when combined with cyanogen. We reserve for some future occasion the results of our researches on other quinolic combinations, and on the decomposition of metallo quinolic compounds.—*Comptes-Rendus*, lvii., 837, 63.

Solubility of Nitrate of Soda in Water, by M. MAUMENE.

100 parts of water dissolve at—

0° C. . .	70·94	parts of the fused nitrate.	
10° . .	78·57	„	„
20° . .	87·97	„	„
30° . .	98·26	„	„
40° . .	109·01	„	„
50° . .	120·00	„	„
60° . .	131·11	„	„
70° . .	142·31	„	„
80° . .	153·72	„	„
90° . .	165·55	„	„
100° . .	178·18	„	„
110° . .	194·26	„	„
119·4° . .	213·43	„	„

The above are the mean results of five experiments at each different temperature.

TECHNICAL CHEMISTRY.

The Absorbent Power of Starch for the Coal-Tar Colours, by J. W. YOUNG.

By adding wheaten starch to a dilute, cold, aqueous solution of mauve, magenta, azuline, &c., the colouring-matter is absorbed, and the supernatent liquor rendered nearly colourless, when left in contact for a few hours, with occasional agitation to ensure an equal absorption of the colouring-matter by the starch.

In the case of azuline, a moderately-strong solution was prepared, and treated with starch as above; every trace of blue was absorbed, and the supernatent liquor had a reddish tinge, due to the red colouring-matter which generally accompanies solutions of azuline. When a more dilute solution of azuline was used, every trace of colour was absorbed, and the liquor on filtration was clear and perfectly colourless.

The most of the colouring-matter may be removed from the starch again by solution in alcohol.

By this process almost every variety of colour may be procured—yellow, pink, various shades of red, blue, mauve, &c.

PHARMACY, TOXICOLOGY, &c.

The British Pharmacopœia.

The following list, we believe, will be found to include most of the alterations of names in what we must now call the late London Pharmacopœia, and also the additional preparations now for the first time introduced into the National Pharmacopœia. Several preparations, the old names of which are retained, have been altered in strength; and to each of these we shall call attention as we go through the book:—

Old Names.	*Additions and New Names.*
Acidum aceticum.	Acidum aceticum glaciale.
	Acid. sulphurosum.
Antim.-pot. tartras.	Antimonium tartrat.
Mistur. camphoræ.	Aqua camphoræ.
	Confectio sulphuris.
	„ terebinth.
	Extract. colocynth. co.
	„ calumbæ.
	„ ergotæ liquid.
	„ opii liquid.
	„ pareiræ liquid.
	Fel bovinum.

Old Names.	*Additions and New Names.*
	Ferri arsenias.
	„ oxidum magneticum.
	„ sulphas granulat.
	Ferrum redactum.
Hydrarg. ammon. chlor.	Hydrargyr. ammoniat.
„ nitrico oxyd.	Hydrargyr. oxyd. rubr.
	Infusum aurantii.
	„ catechu.
	„ cusso.
	„ dulcamaræ.
	„ ergotæ.
	„ matico.
	„ senegæ.
	„ sennæ.
	„ uvæ ursi.
	Liniment. aconiti.
	„ belladonnæ.
	„ cantharidis.
	„ chloroform.
	„ crotonis.
	„ iodii.
	„ terebinth. acet.
Liq. potasa. arsenit.	Liquor arsenicalis.
	„ atropiæ.
	„ calcis saccharat.
	Liq. hydrarg. nitrat. acid.
	„ potassæ permangan.
	„ sodæ arseniatis.
Liq. sodæ chlorinatæ.	„ sodæ chloratæ.
	„ strychniæ.
	Mistura creosoti.
	„ scammonii.
Mistura acaciæ.	Mucilago acaciæ.
	„ amyli.
	„ tragacanthi.
Myristicæ oleum.	Myristicæ adeps.
	Pil. aloes Barbadoes.
	„ socotrin.
	„ et assafœtid.
Pil. galbani co.	Pil. assafœtidæ co.
	„ calomel co.
	„ colocynth et hyoscyam.
Pil. ferri co.	„ ferri carbon.
	„ „ iodidi.
Pil. saponis co.	„ opii co.
	Potassæ permangan.
Potassæ bitart.	„ tartras acid.
Pulv. cinnam. co.	Pulvis aromaticus.
	„ catechu co.
Pulv. cretæ co.	„ cretæ aromat.
„ „ c. opio.	„ „ aromat. c. opio.
„ ipecac. co.	„ ipecac. c. opio.
„ kino co.	„ kino c. opio.
	„ rhei co.
	Spirit. cajeputi.
	„ chloroformi.
Spt. ether nitrici.	„ ether nitrosi.
	„ juniperi.
	Succus conii.
	„ scopariæ.
	Suppositor. acidi tannici.
	„ morphiæ.
	Syrup. hemidesmi.
Syr. rosæ.	„ rosæ gallicæ.
	Tinct. bucco.
Tinct. camphor. co.	„ camphoræ c. opio.
„ catechu co.	„ catechu.
	„ chirettæ.
„ colchici.	„ colchici semin.
„ conii.	„ conii fruct.
	„ croci.
„ sesquichlor.	„ ferri perchlor.
„ iodinii co.	„ iodinii.
	Tinct. sabinæ.
	„ senegæ.
Tinct. sennæ co.	„ sennæ.
„ valerianæ co.	„ valerian. ammon.
	Trochisci acidi tannici.
	„ bismuthi.
	„ catechu.
	„ morphiæ.
	„ morph. et ipecac.
	„ opii.
	Ungt. aconitiæ.
	„ atropiæ.
	„ calomel.
	„ cocculi.
Ungt. gallæ co.	„ gallæ c. opio.
„ hydr. ammon. chlor.	„ hydrarg. ammoniati.
	„ „ iodid. rubri.
„ „ nitric. oxyd.	„ „ oxyd. rubri.
	„ plumbi carbonat.
Cerat. plumbi co.	„ „ subacet.
„ resinæ.	„ resinæ.
	„ simplex.
	„ terebinthinæ.
	„ veratriæ.
Ungt. zinci.	„ zinci oxidi.
Vin. antim. pot. tart.	Vin. antimoniale.
	Zinci valerianas.

Some of these changes of name will seem to our readers altogether uncalled for. Why, for example, should Pil. galbani co. for the future be called Pil. assafœtidæ co.? Great confusion also will arise from having an *Ext.* coloc. co. as well as *Pil.* coloc. co., inasmuch as prescribers have scarcely got into the habit of prescribing the pill when they meant the old extract. Other changes are open to graver objections; but these we shall leave until we have the entire work before us.

The Weights and Measures of the British Pharmacopœia.

As was long ago announced, the Medical Council have adopted the avoirdupois pound and ounce in the new Pharmacopœia. The reasons for it are given in the following extract from the preface to the work. It will be seen that the fluid measure remains the same:—

"Under any circumstances it would have been necessary on this occasion to revise the pharmaceutic weights and measures of the kingdom. But change became imperative for one division or another of the country, as the Dublin College of Physicians, in their last Pharmacopœia, had led the way by adopting for the first time in pharmacy the imperial weights for the ounce and higher denominations; a departure from long established usage which appeared to the Council judicious and worthy of imitation.

"The three Colleges had long agreed in adopting the imperial measures for every denomination above the fluid ounce. For the latter denomination a convenient subdivision had been also based on the old pharmaceutic principle, that each fluid ounce should consist of eight parts, called fluid drachms, and each of these of sixty parts, called minims. It was impossible to improve that now familiar division.

"The Council, in resolving to adopt for pharmacy the imperial ounce and pound, could not assimilate the subdivision of the ounce to that of the fluid ounce, without substituting a new medical grain for the troy grain, hitherto the medical as well as the standard grain of the kingdom. This alteration they did not consider advisable; it has, therefore, appeared to them a necessary consequence, that the drachm and the scruple, the old denominations of weight between the ounce and grain of pharmacy, must be abandoned, since they can no longer exist as both simple multiples of the latter, and integral parts of the former. Accordingly, all who prescribe and dispense medicines are recommended to discontinue henceforth the use of the drachm and scruple weights.

"The weights and measures of the British Pharmacopœia with their symbols will now stand as follows:—

"Weights.

1 pound ...	lb.	...	=	16 ounces	=	7000 grains.
1 ounce ...	oz.	...	=	...	=	437·5 grains.
1 grain ...	gr.	...	=	...	=	1 grian.

"Measures.

1 gallon ...	C.	...	=	8 pints	...	O. viij.
1 pint ...	O.	...	=	20 fluid ounces		fl. oz. xx.
1 fluid ounce	fl. oz.	...	=	8 fluid drachms		fl. drs. viij.
1 fluid drachm	fl. drm.		=	60 minims	...	min. lx.
1 minim ...	min.	...	=	1 minim	...	min. j."

These changes in the weights need not occasion dispensers much trouble. Doubtless, cases will often happen in which it may be open to question whether the troy or avoirdupois ounce is meant; but it can rarely happen that the substitution of either for the other will be of material consequence. Although the drachm and scruple are here omitted from the table, there is no doubt that these weights will be continually used, and it is only necessary to remember that they retain their value in grains, but are no longer aliquot parts of the ounce.

PHYSICAL SCIENCE.

The Ultra-violet Rays of the Solar Spectrum,
by M. MASCART.

THE method of obtaining these rays is precisely that used for observing the luminous spectrum. I used a goniometer, with collimator and two lenses of quartz cut perpendicularly to the optical axis, so that the rays traverse them in directions very little inclined on this axis. The refracting prism is also of quartz, cut parallel with the axis, and I generally observed the principal spectrum, which is the most deviating. A system of lenses like this is entirely deprived of achromatism, but this effect does not prevent the production of a pure spectrum, and has no other effect than to cause a considerable change of position when passing from the less refrangible to the more refrangible rays. The mounting of the eye-piece is furnished with a net-work of cross threads, and the eye-piece itself, at its interior extremity, has a photographic plate, with its sensitive face exactly behind the net-work, so as to take the impress of the phenomenon produced on its plane.

By this means the chemical region to be explored can, even though invisible, be rapidly brought to view. It is only necessary to produce on the plane of the net-work a defined image of the extreme limit of the luminous spectrum, of the ray H, for instance; the eye-piece is then pushed in a little further to bring the point towards the more refrangible parts, and an experiment is made by substituting for the eye-piece of the lenses the photographic eye-piece. Examination of the result indicates in what direction the net-work requires to be displaced. The want of achromatism of the lenses admits of clear results only within confined limits, and, as the energy of the action is very unequal in different parts, the time of exposure ought also to vary; it is then necessary to multiply the experiments, and no less than eight trials are required to produce the entire chemical spectrum.

It is obvious that a high degree of perfection of detail may be attained, as the rays concentrated on a very small surface always possess sufficiently energetic action, however small the chink may be. I used collodion sensitive enough to give an ordinary photograph in five or six seconds, and the time of exposure in my experiments has never exceeded a minute and a-half. The proofs obtained may be put into a solar microscope, and enlarged positives taken, but the results are mediocre; it is better to examine them by the microscope, to measure the distances of the rays with a micrometric screw mounted on the object-glass, and to draw them very carefully. I obtained my chart in this way; the distances are not exactly proportioned to the deviations, on account of the small variations in thickness. I have more especially endeavoured to reproduce the general aspect, the form of each group, with the relative intensities of the rays.

Some physicists, notably MM. Ed. Becquerel, Stokes, and Esselbach, are already occupied with this question, and have indicated by letters the principal groups of rays. Their denominations do not always accord; the charts are sometimes so imperfect as to make it difficult to recognise them, and, besides, names have been given both to the dark and to the brilliant places. I have taken as a guide the plate published by M. Müller in his "Traité de Physique," applying each letter to the most remarkable dark ray in the group it served to indicate.

To give an idea of the precision attainable, it will suffice to remark that the luminous spectrum drawn by Fraünhofer comprehends 320 rays, from A to H, and that in an angular space about equal to that from H to S, I found more than 280: the results are then comparable to those obtained with the sun. The dispersion may be increased by multiplying the refracting prisms, as M. Kirchoff has done, for observing in the same way the brilliant chemical rays of coloured flames, and comparing [them with the obscure rays of the solar spectrum. When circumstances allow me I propose to return to this subject.

To conclude, the measure of the differences in the length of the wave may be made with adequate exactness. The net-work which is before the sensitive plate is projected and engraven on the proofs; we thus identify the ray corresponding to the deviation observed. By arranging a great many similar measurements along the whole length of the chemical spectrum, we may easily, by the help of a chart, fix the deviation of a ray, situated between two positions of the net-work. The lengths of the wave are measured with the same facility. I have obtained very satisfactory results with a net graduated to 440 c. of a millimetre; but I dare not now venture to publish the numbers, as in measuring the lengths of the luminous rays I have arrived at results differing too much from those of Fraünhofer to be accepted without numerous verifications.—*Comptes-Rendus*, lvii., 789, 63.

Soap for Very Dirty Skins.—Under this title E. Janota gives the following receipt:—Two pounds of finely rubbed carbonate of magnesia are to be mixed in a porcelain dish with eight pounds of water-glass and eight pounds of rain water. To these four pounds of oleic acid are added, and the whole is gently warmed and stirred as long as carbonic acid is evolved. Lastly, a pound of crystallised carbonate of soda dissolved in some warm water is added, and the mass is dried and made into shapes. The water-glass need not be diluted, as, on mixing it with carbonate of magnesia, carbonate of potash is formed, which perfectly saturates the oleic acid.—*Chemisches Centralblatt*, No. 54, 1863.

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

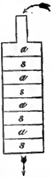
Lecture III.—*Thursday, December 17, 1863.*

Ladies and Gentlemen,—At our last meeting I directed your attention especially to the subject of alumina, a base consisting of a metal termed "aluminium" and of oxygen. It exists extensively diffused through nature, and is the essential constituent of all clays, or, at all events, I should say, *an* essential constituent of all clays. It exists in nature beautifully crystallised, and is then known as corundum. When coloured blue, it is termed sapphire—when red, ruby. Sometimes this corundum occurs opaque from the presence of impurities, and then we have it in the form of common emery. In the laboratory of the chemist dried alumina is known simply as a white amorphous powder, excessively insoluble and infusible. Having described the physical and chemical properties of alumina, we proceeded then to examine certain methods by which it can be obtained in a crystalline form, and I directed your attention especially to the plan of Ebelmen, and showed you a specimen of alumina crystallised by his method. It consists in heating alumina for a long time at a high temperature in a platinum vessel with borax. The borax first of all dissolves the alumina, and then the elements of the borax separate therefrom and volatilise, and leave the alumina in a crystallised state. We next examined another method by which alumina can be crystallised, by which it can be obtained blue, red, or green—namely, by bringing the colourless gas, fluoride of silicon, in contact with the vapour of boracic acid at a tolerably high temperature. Mutual decomposition takes place, fluoride of boron escapes, and the alumina is left distinctly crystallised. The colours, both red and blue, are communicated by a small quantity of chloride of chromium; and it is remarkable that the same colouring matter, that is, chloride of chromium, should, under apparently identical conditions, communicate sometimes a red and sometimes a blue colour. We will now pass on to consider further this part of our subject.

In the first place I shall direct your attention to a singular and beautiful mineral known as "staurolite," which has been prepared artificially.

Let me just say one word by way of caution. It does not follow that the methods by which we can prepare mineral matters crystallised in the laboratory, should be precisely those which Nature herself has adopted on a great scale, though in many cases there is no doubt that the processes which we have employed in the laboratory are really identical with those which Nature herself has employed. Then, again, there is another very important point which we should bear in mind. The same mineral substance may be produced by methods entirely distinct. I shall show you by-and-by the well known and beautiful mineral termed "felspar," which can be produced both by the agency of liquids at a tolerably high temperature, and also directly by igneous fusion. I shall present to you specimens of magnificently crystallised felspar taken from furnaces, where there is no doubt about the mode of its production.

And now for this mineral, staurolite, which is a silicate of alumina. We are indebted to Deville for a singular experiment regarding the formation of this mineral. It does not at all follow that the process I am about to call your attention to should be exactly that which Nature herself has adopted, but still it is remarkably illustrative of what may occur, and on that account I bring it in some detail before your attention. We take a porcelain tube, and place it vertically in a furnace. It is open at both ends, and we introduce through the upper part of the tube the gas, fluoride of silicon. At the top we have a layer of alumina, which I will designate by the letter A; then there is a layer of silica which I will designate by the letter S; and so on in alternation—alumina, silica, alumina, silica—beginning with alumina, and finishing with silica. We will heat that tube to red whiteness, and then note the result. The gas, fluoride of silicon, is a compound of fluorine and silicon. When it comes in contact with the alumina a curious reaction takes place. A portion of the silica is deposited here, and we get the mineral silicate of alumina, a corresponding proportion of the aluminium being displaced and volatilised in the form of fluoride of aluminium. It is important clearly to understand this part of the operation. You perceive that we bring fluoride of silicon in contact with alumina, that is, with a compound of aluminium and oxygen. A reaction takes place between those two substances at this temperature, whereby silicate of alumina is produced. The mineral, staurolite, happens to be this particular silicate of alumina, and fluoride of aluminium is evolved. That descending, and coming in contact with the stratum of silica beneath, undergoes a change similar to that which the fluoride of silicon underwent in the first instance, and we get the same mineral formed in the second layer from silica as was formed in the first layer from alumina—in one instance by the action of fluoride of silicon, and in the other by the action of fluoride of aluminium. At the second decomposition there is fluoride of silicon evolved, which acts upon the aluminium below exactly as in the first instance, and so it goes on in succession, and at length you obtain the tube full of the mineral, staurolite—this silicate of alumina, and yet you have only employed a small amount of fluoride of silicon in the first instance to effect this transformation. Thus, by a small amount of this body you can convert an indefinite quantity of alumina and silica into this mineral. As much fluoride of silicon finally escapes from the tube as entered it in the first instance. It is one of the most beautiful and striking experiments I know in the whole of this department of science. The staurolite produced in this way is crystallised.



We pass on to a few remarks on another curious and important mineral,—namely, topaz. This is a compound the precise rational composition of which does not appear to be very clearly understood even at the present time. It is essentially a silicate of alumina containing fluorine, but some doubt is entertained as to the exact mode in which that fluorine exists in the compound.

Now, one might have reasonably anticipated that topaz might have been produced in some such way as that I have just explained with regard to the production of staurolite; but, according to Deville, who tried the experiment, topaz cannot be so formed. There is, however, some little discrepancy in the statements which have been made on this point; for Daubrée states that it is formed by heating alumina to redness in a current of fluoride of silicon. We must wait for further information, seeing that these two chemists disagree on the subject. But if topaz cannot be so formed, a peculiar mineral termed "zircon," which is a silicate of zirconia (zirconia corresponding in formula with alumina), may be produced in beautiful crystals when the fluoride of silicon is passed over zirconia. Take a tube containing zirconia, and heat it to a pretty good red heat, or more than that, and then pass over the gas fluoride of silicon, and you obtain the mineral crystallised—a silicate of zirconia. It occurs, Deville says, in octahedral crystals, and these crystals exactly resemble those of Monte Somma in Vesuvius. He assures us that they have the same faces, the same angles, and the same external characteristics ; so that he concludes that it is almost certain that they must have resulted from the same process—from the same operation of fire. Every mineralogist knows that certain specific minerals have peculiarities according to the locality, and these must depend upon certain conditions attending their formation. Now, as these crystals of zircon possess such an assemblage of characteristics, I think we may reasonably admit that Deville's conclusion has something like a good foundation to rest upon. Then he further remarks, it may be demonstrated that the small quantities of fluor existing in the metamorphic rocks, or rather beds of this kind, have sufficed to form indefinite quantities of zircon. We shall, by-and-by, direct attention to the subject of fluor, which may have played a very important part in the economy of nature,—a much more important part than many persons are yet disposed to admit. It is, as we shall see, a very widely-diffused element, though occurring only in small quantity.

When the same experiment, to which I alluded, was made entirely with zirconia, instead of alumina, the whole contents of the tube were completely transformed into zircon. Zircon occurs in rocks which, there is reason to believe, have been exposed to a tolerably high temperature. It occurs in the syenite of Norway, for example, replacing felspar ; so that the rock consists only of hornblende, zircon, and a small quantity of quarts ; hence the rock is designated "zircon-syenite."

The next mineral which it may be interesting to examine is the mineral termed "cryolite," which, in fact, forms a geological bed. It is an exceedingly remarkable mineral. I presented to you a specimen of it at the last lecture, as being a source of aluminium,—a large white lump, fusible at a comparatively low temperature. It is, as I then told you, a compound of fluoride of sodium and fluoride of aluminium. Its formula is $3NaFl + Al_2Fl_3$. It is an anhydrous mineral—that is, free from water. It contains about 13 per cent. of aluminium. It is found in Greenland in a layer in gneiss, and in the vicinity of mica. According to Bischoff, there is a quantity of mica about it which he supposes has played a very important part. The bed of cryolite is eighteen feet thick. Cryolite is associated with various minerals which undoubtedly are of aqueous origin. For example, iron pyrites,—though certainly not prepared at a high temperature—copper pyrites, galena, and sparry iron ore, which certainly never could have occurred at a high temperature,—these are the associates of cryolite, and they tell us the story of its formation. It is clearly produced by the agency of water as a solvent. It may be produced by melting together directly fluoride of aluminium and fluoride of sodium. It may also be formed in the wet way by digesting fluoride of sodium with excess of hydrochloric acid and common gelatinous alumina.

Bischoff supposes mica to have played a very important part as a source of fluorine,—indeed, as a source of fluorine in common fluor spar which we meet with in so many localities.

The next subject for our consideration is one of considerable importance—of the highest importance, I may say. It is that of calcium and lime.

All lime, like alumina, contains a metallic base. Calcium, the base of lime, is exceedingly light, has a yellowish colour, is readily fusible, and exceedingly oxidisable, so that it is impossible to expose it to the air without its undergoing oxidation—contrary to what we have seen is the case with aluminium. I understand that recently some important experiments have been made by Wöhler on the subject. He has discovered certain combinations of carbon and calcium, equivalent to those known in iron—in the form of pig iron.

It is with lime especially, and its compounds, that we have to do. Lime is composed of one equivalent of calcium and one of oxygen. You are all familiar with the properties of lime—an amorphous body, white, or more or less coloured with impurity, and which, on the application of water, slacks; that is, it absorbs water, the water enters into combination with it, and becomes solid, and on its passing from the liquid to the solid state, a large amount of heat is evolved. The lime falls to pieces, having become hydrated, or, in common language, slacked. It is slightly soluble in water, as every one knows, producing the well-known liquid called lime-water. When combined with water—for it must be hydrated—it unites readily with carbonic acid, forming carbonate of lime.

Carbonate of lime is a mineral which occurs very extensively in nature, forming beds of chalk, limestone, and two very important minerals, namely, calcite and arragonite. Carbonate of lime is a compound of one equivalent of carbonic acid and one of lime. It is known in three distinct states. There is, first, the amorphous or chalk-like state. We will call it chalk. It is perfectly non-crystalline, or amorphous. There is, then, the form of arragonite which occurs in prismatic crystals, and belongs to the prismatic system. The third form of carbonate of lime is that of calcite or calcspar, which is rhombohedral, crystallising in the beautiful rhombohedral crystals with which every mineralogist is familiar. Arragonite varies in specific gravity from 2·93 to 3·01. This is a point to note. The calcite has a lower specific gravity, ranging from 2·69 to 2·75, so that not only in their crystalline system, but also in specific gravity, are these two minerals distinguished clearly from each other.

The next point on which I shall speak is the solubility of carbonate of lime. In treating this subject of chemical geology, I am selecting all those points which I conceive have a direct geological bearing ; and it is requisite to pay rather close attention, which, perhaps, may be considered tedious, to this part of our subject. One part of carbonate of lime dissolves in 110,000 parts of pure water, in round numbers. It is 110,132 parts really. This carbonate of lime dissolves to a much greater extent when carbonic acid is passed through the water, and it then forms what is termed bicarbonate of lime. One part of carbonate of lime dissolves in 998 parts of water containing carbonic acid, according to Bischoff, the carbonic acid being passed through the water for an hour. He has made several experiments upon this subject, which are remarkable. He finds that the solubility varies to a great extent with the nature of the carbonate of lime operated upon. Thus, 11·15 parts of chalk were dissolved in 10,000 parts of water by passing carbonic acid through for an hour. He performed this experiment three times, and each time he obtained pretty nearly the same result; but, when he tried the experiment with carbonate of lime precipitated from a salt of lime, passing the carbonic acid through for about the same time as he did in the experiments with the chalk, he found that 28 parts dissolved in 10,000 parts of water. There is another very striking statement, but which, I think, will require further corroboration. It is, that burnt muschelkalk dissolved to the extent of 135·3 parts in 10,000 parts of water, by passing carbonic acid through the water for an hour and a-half.

In passing, I will just mention the fact, that when arragonite is exposed to a red heat, it falls to powder ; and it was supposed for a long time that this powder consisted of minute rhombs of calcite. This, however, I find denied by Gustave Rose, who contends that the powder is strictly amorphous.

Let us now consider the mode of formation of arragonite, or the conditions under which it may be produced ; and, when we understand these conditions, I think we shall find that the information afforded will tend to elucidate the formation of certain geological phenomena, especially with reference to temperature. It will indicate to us the temperature and other conditions under which rocks containing arragonite may have been formed.

Arragonite may be formed by dropping common chloride of calcium in molten carbonate of potash or soda. The method is to melt the carbonate, and then drop in the chloride of calcium. Decomposition occurs, and chloride of potassium or sodium and carbonate of lime are formed. We owe to Gustave Rose several experiments upon this subject, which, though they may seem somewhat minute and tedious, are extremely important and interesting. In the molten state the mass is clear, but it becomes opaque and white on solidification. Upon washing the product with cold water, an amorphous carbonate of lime or chalk, as I may call it, was produced. It was always obtained at first in minute microscopic globules, perfectly amorphous, or non-crystalline; but Rose tells us that after twenty-four hours the whole became changed into rhombic crystals of calcspar. That is a curious point. I must ask your particular attention to the temperature of the water employed, and the degree of dilution, for all depends upon those two conditions. On the other hand, by boiling the product in water, instead of washing it with cold water, the globules are almost instantly changed, not into rhombs of calcspar, but into prisms of arragonite. This little difference of temperature, then, is sufficient to effect this great change. These microscopic crystals of arragonite being left to cool in the water, become transformed into rhombs of calcite. He found that the same results were obtained by substituting chalk, arragonite powder, or calcspar, for chloride of calcium. Some experiments on this subject were made a long time ago by Becquerel, to whom we are deeply indebted for a great variety of experiments bearing on the subject of mineralogy. He was one of the first to take up the subject energetically. He formed arragonite by leaving plates of selenite or gypsum during several years in contact with a solution of bicarbonate of soda of the specific gravity of 1·070. The result of the decomposition was sulphate of soda and carbonate of lime. The carbonate of lime produced appeared in the form of crystallised arragonite. The crystals consisted of very acute double pyramids, base to base, thus producing a very acute dodecahedron. The same result was obtained in a few days by heating to the boiling point (100° C.) plates of selenite in a solution of bicarbonate of soda, saturated cold. The solution was contained in hermetically-sealed tubes of glass, and great pressure was given by a very ingenious artifice. There was no necessity in this case for raising the temperature of the glass very high to get the pressure. The pressure required was about five atmospheres, and this was obtained by half filling the glass with the solution in question, and then putting in a few drops of bisulphide of carbon, which is an exceedingly volatile body. It was inert, having no effect whatever upon the solution, but it enabled him to get a pressure of five atmospheres at this low temperature. He tells us that the crystals of arragonite which he thus formed were very distinct and very limpid, and in ten days they were $\frac{1}{100}$ths of an inch on the side.

I especially commend these various points to your attention. They are apparently very small and trivial, but I think you will admit that in their application they may be of considerable importance, as small things, or what appear to be small things, very often are. Gustave Rose found that, by leaving a very dilute aqueous solution of carbonate of lime in excess of carbonic acid, freely exposed to the air, arragonite was formed. All depends upon the solution being very dilute and at the ordinary temperature. If a common solution of carbonate of lime in excess of carbonic acid is thus left exposed, you will get, not arragonite, but crystals of calcite. That is a remarkable fact. By heating a common solution of carbonate of lime—that is, a solution containing the ordinary amount of carbonate of lime dissolved by virtue of the presence of carbonic acid—you get arragonite, and not calcite. An ordinary solution of carbonate of lime, or—what is equivalent—a much stronger one, gives calcite by exposure at the ordinary temperature; and this same solution, when heated, deposits arragonite. If such a solution be evaporated in a platinum vessel, the residue contains carbonate of lime in all three forms, namely, the amorphous, or chalk, arragonite, and calcspar. That is an important point.

Having obtained these results, Rose then went on to investigate the precise changes corresponding to different degrees of temperature. I will give you his chief results. At 100 centigrade—that is, the boiling point of water—the greatest part of the residue was arragonite in characteristic small prisms. At 90° the most arragonite was formed, and the crystals were larger than at other temperatures. At 70° the rhombic crystals of calcspar predominated, and were accompanied by hexagonal plates and small stars of calcspar, and the arragonite crystals were small. At 50° there was more calcspar, and the proportion of plates and stars as compared with the rhombs of calcspar increased. The arragonite crystals were thicker, and often bent or curved. At 30° no arragonite whatever was formed. The rhombic crystals of calcspar were comparatively large, and there were still some plates and stars. I think that you will agree with me that it was very remarkable that he should get these varieties of deposit under these different degrees of temperature and solution. All the arragonite occurred at a higher temperature than 30°, and the hexagonal plates of calcspar were formed at a lower temperature than 70°. Calcspar is always formed in solutions containing carbonate of lime, when carbonic acid is set free. By exposing in a warm place a well-stoppered vessel containing a concentrated solution of carbonate of lime in excess of carbonic acid, crystals of calcspar were deposited.

Experiments were also made by Rose, with especial regard to the influence of the degree of dilution, and so forth, upon the result. He took two ordinary small flasks—one containing a very dilute solution of carbonate of soda, and the other containing a dilute solution of chloride of calcium; he tied them together, and then immersed them in a cylindrical vessel of water. He left them under the water, and, in consequence of diffusion, a mixture took place with extreme slowness, the chloride of calcium mixing with the carbonate of soda. In this case, the result was the formation of arragonite; and if the solutions were a little stronger, he then got calcspar. The conclusion, therefore, is, that, under special conditions of dilution, arragonite may be formed even at the ordinary temperature.

I am sorry to be obliged to weary you with so much detail, but it really is essential to the right understanding of our subject, and I cannot avoid it.

In native arragonite a little carbonate of strontia is found frequently, but not always. Its maximum amount, taking a goodly number of analyses recorded, I find to be stated at 2½ per cent, It ranges from nothing to 2½ per cent. At one time it was supposed that the carbonate of strontia was a universal and essential constituent of all arragonite, and that this determined its crystalline form. That opinion, however, has been shown to be an error, because we not unfrequently find arragonite free from strontia. A little water is also generally present in arragonite. I find that the extremes given by a number of analyses are 0·17 per cent. and 0·41 per cent. Water is given as a constituent in all of them. Arragonite is deposited from hot springs, as at Carlsbad, where there is a well-known spring, to which I shall have to refer again in connection with the subject of fluor spar. It occurs also in gypsum at Molina, in Arragon, and at Dax, in the Landes. It is also found in basaltic rock, in the serpentine rock in the Valley of St. Nicholas, in Piedmont, in lavas in Vesuvius and Iceland, in beds of brown iron ore at Saalfeld, the Harz, and Styria.

We now come to the mineral calcite, calcspar, or Iceland spar, of which you will see a very magnificent specimen here in the museum. There are some specimens before you very beautifully crystallised. This calcite is pure carbonate of lime. So far as analyses tell us, some specimens of Iceland spar are absolutely chemically pure. Sometimes they contain about one-half per cent. of water, and they not unfrequently enclose foreign matters, such as copper pyrites and sand.

Next as to the formation of calcite. Calcspar, or crystallised carbonate of lime, crystallises in the rhombic system. We have seen that it can be produced by means of water. We will now consider its production through the agency of fire only. We have all heard of the famous experiments of Sir James Hall, the record of which now lies before me. I think they were commenced in 1798, and the results were communicated to the Royal Society of Edinburgh. He informs us that he took amorphous carbonate of lime, or chalk, and by exposing it to a high temperature under considerable pressure he succeeded in converting it into saccharoidal limestone, like Carrara marble. I have had an opportunity of seeing one specimen prepared by Sir James Hall himself, and I must say that the result did not strike me as conclusive. But now for the evidence. He enclosed carbonate of lime in gun barrels, and resorted to various expedients of plugging those gun barrels, such as plugs of soft metal and so forth. He then exposed a portion of the gun barrel to a high temperature, taking care to arrange the tube horizontally in such a manner that the plug of soft metal should not be melted; and he obtained a hard substance like limestone after having exposed chalk to these conditions. He says, "My first application of this scheme was carried on with a common gun barrel cut off at the touch-hole, and welded very strongly at the breech by means of a plug of iron. Into it I introduced the carbonate, previously rammed into a cartridge of paper or pasteboard, in order to protect it from the iron, by which in some former trials the subject of experiment had been contaminated throughout during the action of heat. I then rammed the rest of the barrel full of pounded clay previously baked in a strong heat; and I had the muzzle closed like the breech, by a plug of iron welded upon it in a common forge, the rest of the barrel being kept cold during this operation by means of wet cloths." This gives you an idea of one of his experiments. Then he comes to the use of fusible metal. He employed tubes of glass. I wish particularly to examine the evidence upon this subject, because it is one on which much stress has been laid. I do not wish to question unnecessarily the accuracy of Sir James Hall's conclusions, but I may remark that the carbonate of lime being heated to a high temperature in contact with glass, the result would be altogether vitiated, and the crystallisation could not be said to depend merely upon the outward conditions to which the substance was exposed. We find that in other experiments he used small quantities of carbonate of lime in contact with silica and clay; but the presence of these two bodies would very much modify the result. In other experiments he used borax, and that again would altogether vitiate the result. Therefore, the conclusions drawn from these experiments are unworthy of being received—at all events, without further evidence. He tells us, that in several cases the material which he obtained, although resembling crystalline limestone, fell to pieces on exposure to the air. That, however, is not the property of crystalline limestone. I have no doubt that the investigations of Sir James Hall were conducted with perfect honesty and candour, and they must have involved a great deal of expense; but, as far as I know, recourse was never had to chemical analysis, and, without that, no result ought to be received. Indeed, Sir James Hall himself confesses his deficiency in chemical knowledge. He tells us, that in various experiments he got a product in glass-like drops which were semi-transparent, and this clearly proves that the carbonate of lime operated upon could not have been pure. Having carefully gone over these experiments, I have no hesitation in stating that, as I said just now, I consider them to be unsatisfactory. "By the lens," he says, "this same surface was seen to be glazed all over, though irregularly, showing here and there some air-holes. In fracture it was semi-transparent, more vitreous than crystalline." Last of all, he uses platinum, to obviate the effect of the iron. The effect of the iron would be to act as a strongly reducing agent upon the carbonic acid by the formation of carbonic oxide, and the tendency to decompose the carbonate would of course be facilitated by reasons which are well known to chemists.

It appears, after all, that Sir James Hall obtained some results which would certainly lead us to believe that, by the application of a strong red heat, carbonate of lime would acquire a crystalline structure; but it is exceedingly desirable that these experiments should be repeated with all possible care, that the question may be cleared up satisfactorily. No doubt they would involve considerable expense; but if proper care were taken, and proper apparatus employed, I have no doubt that we should obtain something like very decisive results. I hope that you will not consider that I have shown the smallest disposition to speak disparagingly of the labours of Sir James Hall. I do attach some importance to these investigations, and I think they are in the highest degree creditable, considering the time at which they were made. They extended over several years; but, looking at the results, I cannot feel that confidence which seems to be generally reposed in them. Some years ago, Gustave Rose took up the subject, and came to the conclusion that Sir James Hall had been entirely mistaken; but more recently he has come to an opposite conclusion. But Rose's experiments are by no means so conclusive as they might be. In his recent experiments, which are published only this year, and will be found in the 118th volume of Poggendorf's Annalen, by employing a wrought-iron vessel, electro-plated with nickel, and capable of being closed—so avoiding the contact of iron at a high temperature with the carbonate of lime operated upon, and, consequently, the reducing action of that metal on the carbonic acid of the carbonate of lime—he succeeded in changing arragonite into a substance having the characteristic appearance of Carrara marble. The experiment, he tells us, was conducted in a Siemen's gas-furnace—that is, a furnace capable of sustaining a long-continued and high temperature. A closed unglazed porcelain vessel was employed, and exposed to a white heat during half an hour, and he informs us, that under these conditions a piece of lithographic stone became greyish-white in fracture, and, under a lens, was found to be finely granular. The product was analysed, and contained,—Lime, 56·61; magnesia, 0·41; carbonic acid, 42·37; residue, 0·45. Pure carbonate of lime contains 56 per cent. of lime and 44 per cent. of carbonic acid. What was the undetermined residue? The presence of a small amount of silica might make a considerable alteration in the result. After carefully examining the way in which Rose's experiment was conducted, it appears to me inconclusive. It is obvious that there could have been no sensible degree of pressure. The porcelain vessel was not in the least injured, so that the temperature must have been much below that which we can now command—as, for instance, in the fusion of platinum. It is most desirable that we should have some further investigation on the subject. The British Association might take up the question with advantage; they have funds at their command, and it would be exceedingly desirable to settle this important point once for all.

What we call carbonate of lime in nature—take even the purest marble—is not pure. At one time I was anxious to investigate this point, and I went to a sculptor and obtained numerous varieties of marble, but in not one of them did I fail to detect alumina. Chalk is an impure body, and the presence of foreign matter might altogether modify the results of experiments made with it. I could show you, for example, a well-known variety of fire-brick, which consists almost entirely of silica. Upon taking hold of it, you will find that it is a hard, solid, enduring brick. You may ask, "How could you get this silica to unite so as to form a hard brick?" For a long time it was kept secret: done by the intermingling of a very small proportion of lime, which caused the formation of one solid brick; and it is very possible that foreign matters might be present, and modify the result of experiments made on the crystallisation of carbonate of lime. We ought to appeal to chemical analysis to inform us what we are doing. It is vain to rely upon experiments where chemical analysis is not brought into use, or we may be led into serious error.

The next question we shall have to consider is, the derivation of lime in nature. What ready source of carbonate of lime is there in nature? According to Bischoff, in his valuable and compendious book on chemical geology, it exists in the so-called Plutonic rocks in combination with silica, forming silicate of lime; and this compound is decomposed by water containing carbonic acid, even when in mechanical suspension in the water. We shall resume this subject in the next lecture.

ACADEMY OF SCIENCES.

January 4, 1864.

THE report of this meeting arrived too late for insertion last week.

A communication by M. BERTHELOT "*On the Proportion of Ethers contained in Brandies and Vinegars,*" was read. This was an application of the author's previous researches on the limits of etherification in definite mixtures of alcohol and water. French brandy, as our readers know, contains water, from 40 to 60 per cent. of ordinary alcohol, with traces of amylic and other alcohols, a part of the volatile acids of the wine, such as acetic, butyric, succinic (?), etc., and, lastly, the volatile ethers of the wine, acetic, formic, etc. Some essential oils, aldehydes and other matters, are present, of which the author takes no account. The point to be determined was the limit of the etherification in a brandy which had been kept for several years. This, as M. Berthelot has shown before, will depend on the proportions of the alcohol and water. Thus, in a brandy containing 60 per cent. of alcohol and 40 per cent. of water, and kept for several years, the free acid will represent half the weight of the acids etherified. In a brandy containing equal weights of alcohol and water, the free acid will be four-fifths of the combined acid; and in an old brandy containing only 40 per cent. of alcohol, the free acids represent five-fourths of the combined. The addition of ready-formed neutral ether to brandy to give it a bouquet, occasions, says M. Berthelot, more complicated reactions than is generally supposed. If a quantity in excess of limit which would be formed in the brandy is added, the ether soon begins to decompose, setting free a part of the alcohol and acid of which it was composed. The limits of etherification in vinegars made from wine, have also been determined by M. Berthelot. He gives a formula, but we quote an example:—In a vinegar containing 60 grammes of acetic acid and 1 gramme of alcohol in a litre, the weight of acetic ether formed in course of time will be equal to 0·12 of a gramme.

In a note which follows, M. Berthelot intends to "shut up" M. Maumené on the question of the action of alcohol on wines. M. Berthelot recommends his opponent to take a bottle of good Burgundy, and decant a part of the wine into a clean bottle, shake it well for a quarter-of-an-hour, so as to mix the wine with air, and then to taste, or get some unprejudiced person to taste, this and also the undecanted wine.

M. MAUMENÉ submitted a note "*On the Solubility of Nitrate of Soda.*" As this salt is of considerable industrial importance, we give the author's results in another part.

A note by M. ALLUARD was read, entitled "*Experiments on the Boiling-points of Mixtures of Two Liquids which mutually Dissolve in all Proportions.*" The experiments were made with mixtures of sulphide of carbon and ether, sulphide of carbon and alcohol, and alcohol and water. The results of the experiments are given in tables, for which we have not space. They were undertaken in consequence of the author having discovered that ether mixed with one-tenth of its weight of sulphide of carbon boiled at the same temperature as pure ether. Similar observations were made with other mixtures. It follows, that the boiling-point is not always a test of purity. To determine the purity of a liquid (the author says), recourse must be had to Regnault's process for determining the elastic force of the vapour, employing successively the static and dynamic method. In this way Regnault discovered the presence of $\frac{1}{1000}$th of a substance added to alcohol or to sulphide of carbon. Another conclusion is, that it is sometimes impossible to separate two liquids by fractional distillations when one is in small proportions. This supports the conclusions of M. Berthelot already published.

A note, by M. SCHUTZENBERGER, "*On the Transformation of Coagulated Albumen and Casein into a Soluble Albumen Coagulable by Heat,*" was presented. This curious result is obtained by dialysis. The author dissolved pure coagulated albumen in as little potash as possible, and treated the albuminate of potash with an excess of acetic acid. The mixture was then dialysed, and as soon as the inner liquid showed no acid reaction it was examined. At first it was clear, but it soon became opalescent. Heat coagulated the albumen; so did mineral acids, and, strange to say, so did alkalies and neutral salts. This happened also with uncoagulated white of egg, which was acidulated with acetic acid and then dialysed. Solutions of casein in hydrochloric acid, after dialysation, gave similar results. The author correctly says, that these experiments are important in a physiological point of view.

January 11.

M. NICKLÉS communicated some results, curious if true, of his observations on the thallium line in the spectrum. He states, that he has found thallic compounds which do not give the characteristic line. For example, in a mixture with chloride of sodium the yellow colour of the sodium completely paralyses the green line. We shall give the paper at length in an early number. M. Nicklés announces that he has obtained an alum with sesquioxide of iron and thallium, $Fe_2O_3 3SO_3, + TlO.SO_3 + 24HO$, which fuses at 100°, and then loses 22 equivalents of water.

MM. Bechamp and Pasteur continue to send communications on Ferments, and M. Maumené also on the Action of Oxygen on Wine.

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. HOFMANN, F.R.S., LL.D., &c., &c.

(NINTH NOTICE.)

(Continued from page 31.)

UNDER the head of "Miscellaneous Mineral Products" are classed some of those substances which have been introduced as "cow-dung substitutes" in calico dyeing. The manufacture of these substances now constitutes an important branch of trade, as our readers will see from a statement here made, that the production of one (arsenate of sodium) amounts to not less than ten or twelve tons a-week in South Lancashire alone. Other substances employed for the same purpose are phosphate of lime, with gelatine, silicate of soda, and stannate of soda, Before we notice these compounds, we may briefly refer to the process. Cow-dung was, and, in some instances, is still used to perfect the mordanting of a cloth before dyeing or printing. The *modus operandi* is difficult to explain, "but," says the Report, "so far as the effects of the cow-dung can be made out, they appear to resolve themselves into the following:—The albuminous and mucilaginous principles present (in the dung) entangle and separate the excess of saline mordant, which, if left mechanically adherent to the cloth, but not chemically fixed thereon, would spread to its imprinted portions, and cause these to take the dye, so as to blur and spoil the pattern. The alkaline quality of the dung both tends, more or less, to neutralise the acid of the mordant, and, by giving it a basic character, to promote its fixation on the fabric. To this fixative effect the calcic phosphates present (in the dung), as also the bitter and resinous principles, are supposed to contribute. It is known that basic salts generally, and basic phosphates in particular, have a powerful attraction for colouring matter; and there is no doubt that the combination of these with the mordants gives superior brightness and fulness to the colours. It is alleged by Mr. Walter Crum, M. Scheurer-Kestner, and other chemists, that the basic oxides of the mordants are liable to assume an allotropic condition, in which their affinity for the colouring matter is lost; and that this change is, in some unexplained manner, prevented by the dunging process."

After this explanation, it will be guessed that one of the first things employed as a substitute for cow-dung was a mixture of phosphate of lime with animal matter—in this case gelatine in place of albumen. Messrs. Mercer, Priocc, and Blyth boil calcined bones with dilute sulphuric acid, separate the solution obtained from the sulphate of lime, and then neutralise it with carbonate of soda. The resulting mixture is then evaporated nearly to dryness. The gelatine is added immediately before use, and the mixture may be used either as a bath or as a paste.

Silicate of soda is also extensively used as a cow-dung substitute, and is one of the best; but for this purpose it is necessary to avoid an excess of alkali in the silicate. Mr. Higgin accordingly neutralises with a suitable acid. The silicate acts by fixing the mordant in the form of a basic silicate, producing tints of great stability and beauty.

Arsenate of soda is made by Mr. Higgin by first dissolving arsenious acid in caustic soda, and heating the arsenite so formed with nitrate of soda in a reverberatory furnace. In this way all loss of arsenious acid by volatilisation is avoided, and the whole of the nitrate is converted.

Another plan, by which the arsenate of soda is obtained as a by-product, is to substitute arsenious for sulphuric acid, to liberate nitric acid for the manufacture of sulphuric acid. It is said, however, that sulphuric acid manufactured in this way "is apt to acquire an arsenical impregnation."

Stannate of soda is most often made by fusing tin ore with nitrate of soda. For printing purposes it is generally employed with about 5 per cent. of arsenate of soda.

A beautiful new blue pigment, called ceruleum, and introduced a few years ago by Messrs. Rowney and Co., is next noticed. It is essentially a stannate of cobalt, but mixed with stannic acid, sulphate of lime, and silica. An analysis by Bleekrode showed it to contain—

Peroxide of tin	49·66
Protoxide of cobalt . . .	18·66
Sulphate of lime and silica .	31·68
	100·00

This compound is of peculiar value, as it retains its tint in artificial light. It does not change, moreover, in contact with air.

There is also a pink colour, into the composition of which binoxide of tin enters largely. "The mode of preparation is as follows:—To a mixture of binoxide of tin, chalk, and quartz sand, there is added about $\frac{1}{50}$th part by weight of chromate of potash. This is dried, pulverised, and calcined in a crucible at an intense red heat. After cooling, the fritted mass is pulverised, and the powder again calcined. It is then only necessary to pulverise for the last time, and to wash and dry the product." This colour has been exclusively used for painting on porcelain, but is also, the Report says, applicable in oil and water-colour painting.

The notices of sulphate of iron and copper salts offer nothing of novelty for extraction.

The next section of the Report is occupied with *Disinfectants;* but, although of great interest, we must dismiss the subject very briefly. Disinfectants are here classed under three heads—the *fixative*, the *antiseptic*, and the *oxidising*.

The *fixative* (*e.g.*, salts of iron, lead, zinc, and copper) act by entering into combination with the volatile products of putrefaction.

The *antiseptic* (*e.g.*, carbolic acid) have the property of arresting the decomposition.

The *oxidising* (*e.g.*, chlorine, sulphurous, and nitrous acids, porous bodies, charcoal, and permanganates) change the character of the decomposition, and render the volatile products comparatively innocuous by assimilating them in character to the products of decay. Much and deserved praise is given to the charcoal air-filters of Dr. Stenhouse, and permanganates of Mr. Condy, both of which, however, are too well known to our readers to call for remark here.

The Reporter next comes to the organic products exhibited.

De Spectraal-Analyse. Akademisch Proefschrift, &c., ter verkrijging van den grad von Doctor in de Wis-en Natuurkunde, aan de Hoogeschool te Utrecht, door HENDRIK CORNELIUS DIBBITS. Rotterdam: E. H. Tassemeijer. 1863.

IT is much to be regretted that this work is written in a language not ordinarily read by scientific men. It is far above the common run of theses for a degree, being, in fact, a complete treatise on spectrum analysis. The historical review is particularly interesting and valuable, the author doing full justice to the discoveries of Wollaston, Miller, Daniel, Herschel, Brewster, and Talbot. Not the least useful part of the introduction is a very carefully compiled bibliography of spectrum analysis. A good account of all the spectra hitherto observed follows, and at the end are some beautifully-executed coloured drawings of various spectra.

Spectropia; or Surprising Spectral Illusions, showing Ghosts everywhere and of every colour. By J. H. BROWN. London: Griffith and Farran. 1863.

THIS is a clever book: the illusions are founded on true scientific principles, which are clearly explained in a well-written introduction. The drawings of the illustrations are exceedingly well executed; but there is too much of the hideous. If ghosts are to be common, their appearance must be made agreeable.

NOTICES OF PATENTS.

2462. *Apparatus to be used in the Manufacture of Sulphuric Acid.* S. PUDNEY, Clapham, Surrey. Dated September 6, 1862.

IN the construction of the chambers ordinarily used for the manufacture of vitriol, the inventor proposes to introduce glass in partial replacement of sheet lead. It is preferred to use a foundation of lead in the form of a shallow cistern of that metal, and then to erect an enclosed superstructure made of sheets of glass connected together by means of ribs and strips of lead.

2483. *Manufacture of Copper from Copper Ores.* J. Fleitmann, Iserlotur, Prussia. Dated September 9, 1862 (Not proceeded with.)

For the treatment of copper ores which contain arsenic, antimony, and phosphorus as impurities, the inventor proceeds, in the first instance, to roast them in the usual manner, and to separate, by known processes, any silver or gold that may be present. Having obtained a copper regulus, contaminated only with the elements above mentioned, it is ground to powder and roasted "dead," and the crude oxide thus obtained is moistened with the solution of a caustic or carbonated alkali, dried, and again exposed to heat, avoiding the use of a degree of temperature which would be sufficient to fuse the oxide of copper, but at the same time high enough to melt the alkali. This process is said to remove the metallic impurities, and, by afterwards washing with water, and reducing the oxide of copper, either by carbon alone, or by that element conjointly with hydrogen, a refined metal of good quality is obtained.

2491. *Extracting the Liquid Portion of Yeast, Spent Hops, &c.* G. Ritchie, Edinburgh. Dated September 10, 1862.

This operation is conducted for the purpose of economising the liquid which is ordinarily retained in the husk or refuse of grains, spent hops, etc., and is effected by the use of a filtering apparatus connected with an air-pump, so that the pressure of the atmosphere may be made available for the separation or extraction of the last portions of liquid from the solid matters.

2508. *Manufacture of a Double Sulphide of Calcium and Sodium.* P. Ward, Bristol. Dated September 11, 1862.

According to this invention, the patentee takes the oxysulphide of calcium (alkali waste), and mixes it in a fresh state with sulphate of soda, so as to produce, by double decomposition, the sulphate of lime and the soluble salt named in the title. The application of heat hastens the conversion, and the relative proportions to be employed depend upon the exact composition of the materials, which vary between certain limits.

2554. *Apparatus for the Manufacture of Gas from Petroleum Oil and Water, or from Cannel Coals, Bituminous Coals, Schists, Tar, Crude Coal Oil, or other Hydrocarbons and Water.* G. Haseltine, Fleet Street, London. A communication. Dated September 17, 1862. (Not proceeded with.)

This invention relates to the construction of a retort composed of three chambers, so as to admit of the introduction of water in its spheroidal state into the lowest chamber of the retort, which is kept at a very high temperature, and in such a manner that the intensely-heated steam may come in contact with the vapour of hydrocarbons simultaneously admitted. As the result of this mode of proceeding, it is said that no carbon is deposited from the naphtha or oils during the generation of the gas, and, consequently, that the maximum illuminating power is obtained. The principle of this scheme is somewhat similar to that involved in the manufacture of gas according to the terms of the specification No. 2458.

2556. *Improvements in Obtaining Hyponitric Acid and Nitric Acid from Nitrate of Soda.* L. Mond, Hesse Cassel, Germany. Dated September 18, 1862. (Not proceeded with.)

For effecting the decomposition of nitrate of soda, it is to be heated in contact with an indifferent metallic oxide, particularly one of the following:—Peroxide of iron, magnetic oxide of iron, protosesquioxide of manganese, the corresponding oxide of cobalt, protoxide of nickel, or oxide of copper. By heating such mixed materials to redness in iron or clay retorts, and conducting the gases into water, a certain quantity of nitric acid is directly obtained, whilst the lower oxides of nitrogen and evolved oxygen may be made available in the production of sulphuric acid. The residue in the retort consists of caustic soda and the unaltered metallic oxide, so that water will extract the alkali, and leave the latter in a state fit for repeated employment.

Mr. Webster claims the heating of nitrate of soda with peroxide of iron or oxide of zinc as a means of preparing simultaneously oxygen gas, caustic soda, and nitrous acid. Professor Wöhler has long since described the reactions by which pure caustic soda and potash may be prepared from their respective nitrates by heating with the black oxide of copper.

2565. *Improvements in the Treatment of Sulphuret of Antimony, and in Obtaining Products therefrom.* W. Glass, Princes Street, Stamford Street, London. Dated September 19, 1862.

This invention refers to the preparation of a sublimed white oxide of antimony from the sulphuretted ores of that metal, with the object of obtaining a pigment of great density which answers some of the purposes of white lead. The native sulphide of antimony, with or without the addition of sulphur or antimony, is heated in a reverberatory furnace with a strong air-blast directed upon its surface, so as to oxidise the two constituents of the ore, and give rise, on the one hand, to the production of sulphurous acid, which may be economised in the manufacture of vitriol or in any other way that may be desirable, whilst the oxide of antimony, which sublimes at the same time, is collected in a long flue or chamber in direct communication with the furnace. The residue left on the hearth of the furnace may be treated for commercial antimony, or be refined for gold, silver, or other metals.

This patent is an improvement upon a similar claim, a patent for which has been already granted in the joint names of G. Hallett and J. Stenhouse.

Grants of Provisional Protection for Six Months.

2230. Thomas Brown Jordon, Milton Cottage, South Lambeth, Surrey, "Improvements in granulating and drying gunpowder, and in apparatus to be used therefor."—Petition recorded September 10, 1863.

2892. Edward Chambers Nicholson, Fenchurch Street, London, "Improvements in the manufacture of colouring matters, suitable for dyeing and printing."—Petition recorded November 18, 1863.

3029. Henry Holdrege, Irvington, New York, U.S., "Improvements in the process and manner of making gas for illuminating, heating, and other purposes, a part of which may also be applied to the production of metallic oxides."—A communication from William Henry Gwynne, New York, U.S.

3030. Sanders Trotman, Albert Street, Camden Town, London, "Improvements in the manufacture of soap."

3063. James Alfred Wanklyn, London Institution, Finsbury, London, "Improvements in the production and manufacture of certain yellow and orange colours."—A communication from Eugene Lucius, Hoechst-on-the-Main, Germany.—Petitions recorded December 5, 1863.

3107. Thomas Vaughan Morgan, Battersea Works, Surrey, "Improvements in the treatment and purification of plumbago for the manufacture of crucibles and other fireproof articles, and in apparatus employed therein."

3045. Edward Joseph Hughes, Manchester, "Improvements in the processes of producing aniline black on cotton fabrics or yarns."—A communication from Honoré Cordillot, Dornach, near Mulhouse, France.

3167. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in grinding and polishing glass, and in the machinery or apparatus employed therein."—A communication from James Dodge, Waterford, Saratoga, New York, U.S.—Petitions recorded December 15, 1863.

3183. Charles Humfrey, Suffolk Grove, Southwark, Surrey, "Improvements in dissolving india-rubber."—Petitions recorded December 16, 1863.

2899. Anthony Gapper Southby, Bulford, Wiltshire, "Improvements in stills or retorts for the distillation of petroleum or tars from coal or shale, or the products thereof."

3155. Samuel Smith and Thomas Smith, Fell Street, London, "Improvements in means or apparatus for the manufacture of lozenges."—Petition recorded December 14, 1863.

3207. George Haseltine, Southampton Buildings, Chancery Lane, London, "An improved oil, more especially designed for mixing paints and colours, and a new mode of manufacturing the same."—A communication from Adolph Millochau, New York, U.S.

3046. John Robbins, Oxford Street, London, "Improved methods of obtaining oxygen gas."

Notices to Proceed.

1978. John Thomson King, Liverpool, "Improvements in apparatus for containing and distributing gas for lighting railway-carriages, steamboats, and other movable vehicles and vessels, railway-stations, and other places, parts of such apparatus being suitable for governing the supply of gas and air for various purposes."

1992. Robert Stirling Newhall, Gateshead, Durham, "An improved mode of, and apparatus for, drying chemical compounds and other substances."

2035. Augustus William Parker, Bristol Soap Works, Lewin's Mead, Bristol, "Improvements in the manufacture of soap."—Petitions recorded August 15, 1863.

2078. Richard Archibald Brooman, Fleet Street, London, "Improvements in expressing and filtering oils from seeds and liquids, from other substances containing the same, and in apparatus employed therein."—A communication from Guillaume Cregut and Tschiffeli Brothers, Marseilles, France.—Petition recorded August 21, 1863.

2086. Richard Archibald Brooman, Fleet Street, London, "A new metallic alloy."—A communication from Henry Micolon, Paris.—Petitions recorded August 22, 1863.

2122. George Davies, Serle Street, Lincoln's Inn, London, "Improvements in the manufacture of iron and steel from the cinders and refuse of puddling and other furnaces, and from certain kinds of ores."—A communication from Antoine Leonard Fleury, Philadelphia, Pennsylvania, U.S.

2222. William Clark, Chancery Lane, London, "Improvements in the means of utilising refuse azoted matters of commerce, for the manufacture of various chemical products."—A communication from Amédée Gélis and Lucien Dusart, Boulevert St. Martin, Paris.—Petition recorded September 9, 1863.

2315. Thomas Richardson, Newcastle-upon-Tyne, John James Lundy, Leith, and Robert Irvine, Magdalen Chemical Works, Midlothian, N.B., "Improvements in the extraction or manufacture of oils from vegetable substances."—Petition recorded September 19, 1863.

2146. Henry Edward Kramer, Leipsic, Saxony, "Improvements in printing in colours, pictures, or devices to be used in ornamenting porcelain, stoneware, or earthenware, or any other substances where the colours can be annealed, or melted, or burnt in."—Petition recorded August 31, 1863.

2164. George Whiffen Ewens, Sherborne Lodge, Doris Street East, Kennington Cross, Surrey, "Improvements in the manufacture of wadding, paper, and felted fabrics, and in the preparation of vegetable fibres to be used in such manufactures."—Petition recorded September 1, 1863.

2739. Richard Smith, Glasgow, Lanarkshire, N.B., "Improvements in preparing or obtaining colouring matters."—Petition recorded November 5, 1863.

MISCELLANEOUS.

A Pharmaceutical Bill.—It is stated, in last Sunday's *Observer*, that the Pharmaceutical Society has prepared a bill to compel the registration and examination of all chemists and druggists, which will be presented to Parliament as soon as it meets. We presume our contemporary is misinformed, but it may not be so.

Royal Institution.—Tuesday, January 26, three o'clock, Professor Tyndall, "On Optics." Thursday, January 28, three o'clock, Professor Tyndall, "On Optics." Friday, January 29, eight o'clock, Professor Frankland, "On the Glacial Epoch." Saturday, January 30, three o'clock, John Lubbock, Esq., F.R.S., "On the Antiquity of Man."

Preservation of Animal Substances.—System La Peyrouse.—In reply to some observations made on M. La Peyrouse's patent, the patentee has forwarded to us a pamphlet, from which it appears that the patent has been completed and the process has been in use now for more than two years. The complete success of the method as applied to various animal matters imported from long distances is certified by many scientific and commercial men both in France and this country.

Matches without Phosphorus.—M. Achleitner gives the following mixture as promising all the qualities necessary for producing excellent matches:—

Chlorate of potash	90 parts.
Sulphide of antimony . . .	60 „
Silica	30 „
Nitrate of lead	25 „
Gum arabic	10 „
Olibanum	2 „

First mix the silica with the chlorate of potash (finely powdered), and the gum dissolved in a little water; then add the nitrate of lead and the sulphide of antimony.

To make Muslin Glass.—Stretch out a piece of tulle or muslin of the required size, and apply to it some fatty body by means of a roller; then place it on a well-cleaned plate of glass, and afterwards remove it very carefully. The glass will be found to retain the impression of the fatty body. It must now be exposed for four or five minutes to the vapour of hydrofluoric acid, after which the network will appear polished upon a dull ground.

To Distinguish Artificially-Coloured Wines.—Blume gives the following simple test:—Saturate a piece of bread crumb with the wine to be tested, and place it in a plate full of water. If the wine is artificially coloured, the water very soon becomes coloured reddish violet, but if the colouring matter is natural, the water, after a quarter or half an hour, is but very little coloured, and a slight opalescence only is perceptible. The test depends upon the difficult solubility of the real colouring matters of wine in water free from tartaric acid.—*Elsner's Chem. Techn., Mittheilhungen*, 1862-1863.

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

S. V.—King's College, Evening Classes.

M. P. S.—The Pharmacopœia will appear on the 26th of this month. Copies can then be obtained from any bookseller.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Chemical Studies on Copper, by MM. E. Millon *and* A. Commaille.

Sulphites of Copper.—The composition of these salts, studied and discussed by so many chemists, seems to be decided by M. Péan de Saint-Gilles. By directing a current of sulphurous acid gas into a solution of acetate of binoxide of copper, a yellow precipitate is formed, which redissoves in the liquid; but, on boiling the solution, an abundant deposit of small red crystals takes place. M. Péan gives the composition of these crystals as $Cu_3O_2,2SO_2,2HO$. The total amount of copper and sulphur contained in these red crystals accords with this formula; but, by separately estimating the copper in the state of protoxide and binoxide, it will be found that the proportion Cu_2 is too small by 2 per cent., and Cu too large by 3 per cent. Moreover, it is found that the salt contains just 3 per cent. of sulphuric acid mixed with sulphurous acid.

The exact analysis of this combination indicates 6 per cent. of sulphate of binoxide interposed in the salt described by M. Péan; washing removes none of the sulphate before decomposing the sulphite itself. Sulphate of binoxide seems to be constantly present—a fact we have verified by uniformly obtaining the same figures in three successive preparations of red sulphite. This can, however, be avoided by altering the mode of operation adopted by M. Péan and by MM. Chevreul, Bottinger, Dœpping, and Rammelsberg, who examined this salt before he did. The formula of this compound, obtained free from all mixture, and irreproachably pure, is $Cu_3O_2,2SO_2,2HO$, or $Cu_2O,SO_2 + CuO,SO_2 + 2HO$.

It offers the rather curious analytical peculiarity of furnishing the same numbers in binoxide of copper and in sulphuric acid, whether it is pure or mixed with 6 per cent. of sulphate of binoxide.

The yellow deposit formed by sulphurous acid in a solution of acetate of binoxide of copper, M. Péan considers as a peculiar hydrate of the above salt; he assigns to it the formula $Cu_3O_2,2SO_2,5HO$.

The whole determination of copper made by M. Péan agrees exactly with the preceding formula; but by estimating the relative proportion of Cu_2 and Cu, there appears irreconcilable deviations from this formula, and much more decided than in the analysis of red sulphite.

We have obtained, in various preparations, 7·60, 11·66 and 19.72 per cent. of copper in the state of protosalts; the formula adopted by M. Péan would require 28·78 of copper in the state of protoxide. Notwithstanding the above-mentioned variations in the constitution of this compound, the total estimation of copper always gives the same number, precisely that indicated by M. Péan. Thus, this yellow product represents a mixture in which the weight of copper is a fixed quantity, while the degree of oxygenation of the metal varies enormously.

It is probable that sulphurous acid and acetate of binoxide of copper first form an insoluble and unstable sulphate of binoxide, the molecules of which react on each other, the sulphurous acid oxidising at the expense of the binoxide of copper, until the appearance of the red sulphite, producing a new state of equilibrium among the elements.

We have made several attempts to combine sulphurous acid with binoxide of copper, and succeeded by saturating absolute alcohol with sulphurous gas, and adding hydrate of binoxide of copper. A green powder is the result, insoluble in water, resisting lixiviation, and formed exclusively of sulphurous acid, water, and binoxide of copper.

In this salt, binoxide of copper is quadri-atomic, even when a large excess of alcohol, saturated with sulphurous acid, is used. The formula of this new combination is $SO_3,4CuO,7HO$.

This constitutes a new example to add to those combinations wherein salts with polyatomic oxides are formed, in spite of the presence of an excess of acid.

Ammoniacal Protochloride of Copper and Bichloride of Platinum.—The well-defined reaction of ammoniacal protochloride of copper on salts of silver, which are reduced and give a weight of metallic silver exactly proportionate to the quantity of protosalt of copper, has led us to examine the affinity existing between the protochloride of ammoniacal copper and the bichloride of platinum.

The platinum of the bichloride is not reduced to the metallic state, but is simply brought back to protochloride; however large the excess of protosalt of copper, the reduction proceeds no further. It does not thence follow that the affinity of chlorine is greater for platinum than for silver. There is here a special influence, which must be attributed to the intensity of the combinations formed between protochloride of platinum with ammonia,—combinations whose constitution and nature M. Reiset has so ably explained.

This is what takes place:—On pouring a concentrated solution of bichloride of platinum into a very ammoniacal liquid saturated with protochloride of copper, a violet crystalline precipitate is formed, sometimes of a perfectly pure colour, somewhat like the beautiful tints of some cobaltic salts, sometimes with the colour verging on grey, in which case the crystals are smaller, and always in the form of long prisms with square ends, isolated or irregularly grouped, and often scooped out with two conical cavities approaching at their points.

These crystals, very stable when dry, are insoluble in water or alcohol, and alter only at length by washing; their composition is exactly represented by—

$$\left[\frac{Pt,Cu}{2}\right] \quad Cl,NH_3.$$

Their formula may be doubled, and they may be considered as the combination of an ammoniacal bichloride of copper, $CuCl,NH_3$, described by R. Kane; with Magnus' chloride, $PtCl,NH_3$. But it is more probable that this combination represents the chloride of a base, containing two metals, analogous to the unimetallic bases described by M. J. Reiset; but it differs from the latter in containing both copper and platinum, whose reactions are equally masked. This is, we believe, the first instance of a bimetallic ammoniacal chloride. The reactions of this new compound, both with acids and bases, hardly admit of any other supposition.

We shall have to describe several interesting compounds derived from it; but this would lead us away from the study of copper itself, to which for the present we wish to restrict ourselves.—*Comptes-Rendus*, lvii., 820, 63.

Copper Bronze for Paper Hangings.—Boil ten pounds of logwood twice in water, filter the decoction and evaporate to half its bulk. Then add twenty ounces of tin salt. A precipitate falls, which is separated, washed, and dried. The precipitate has then a dark blue colour, and when mixed with soap-suds, spread on paper, and well rubbed, it gives a brilliant metallic lustre. Alum, or bichromate of potash, may be used instead of the chloride of tin.—*Deutsche Industrie-Zeitung.*

On the Supposed Nature of Air prior to the Discovery of Oxygen, by George F. Rodwell, *F.C.S.*

(Continued from page 28.)

5. **Boyle's Experiments continued.**—*Experiment* 17.[*] A tube three feet long and a quarter of an inch in diameter, closed at one end, was filled with mercury, and inverted in a vessel of the same metal; the latter was placed within the air-pump receiver, and the tube passed air-tight through its cover; on exhausting, the mercury fell nearly to a level with that in the vessel; but the same level within and without the tube could never be attained, because, when the exhaustion was carried on for some length of time, air leaked into the receiver in spite of every precaution. When a quart receiver was used, the first downward stroke of the piston withdrew sufficient air to cause the column to fall eighteen and a-half inches. The falling of the mercury was not, however, entirely due to the removal of pressure, because a minute quantity of air was always present in the space above the mercury, and by its expansion the mercury column would be depressed. The mercury was never boiled in the tube in these early experiments, hence there was always a small amount of air, which was mechanically retained by the mercury, and rose into the so-called vacuum, when the tube was inverted. Boyle states that, when the tube was inclined, the mercury never reached quite to the top of it, and when a hot iron was held near that part of the tube above the mercury, a slight depression of the column was apparent.

Experiment 18. The height of the mercury column in Torricelli's tube was found to vary from day to day, and it did not vary in conformity with the weather-glass.[†] According to Boyle the variation may be caused by ebbings and flowings in the atmosphere, and by sudden changes in its height and density, produced by causes with which we are unacquainted. That changes do take place, he considers is proved by the fact, that the refracting power of the air varies; and miners had related to him that a certain steam, called by them a "damp,"[‡] sometimes arises within mines, and possesses such "thickness" that it extinguishes candles; it may also happen, he says, that fumes ascend from the earth with such rapidity, that the air through which they pass is dragged upwards by them, and a consequent diminution of pressure on that part of the earth beneath the ascending currents, takes place.

Mr. Wren, being asked by Boyle to mention any experiment relative to the pressure of the air which he would wish to be tried, said it would be of importance to observe if the height of the mercury column varied according to the tides, inasmuch as, if it did not do so, Des Cartes' theory, that tides are produced by the increased pressure communicated to the air by the moon at certain times of the day than at others, would be disproved. Boyle did not find the height of the column affected by the state of the tides.

Experiment 19. Having observed, in experiment 17, to what extent a column of mercury could be made to fall on the removal of pressure, Boyle next tried the same experiment with a column of water, contained in a tube four feet long. On exhausting, the water fell to within a foot of the surface of water in the vessel into which the open end of the tube dipped. When air was re-admitted into the receiver, water was driven violently to the top of the tube.

In the 21st experiment Boyle declares he will not say for certain "whether or no air be a primogenial body," incapable of conversion into water; for, although many have affirmed that when water is heated it becomes air, he has observed in chemical distillations that the vapour of water quickly returns to water; and, in the Musæum Kircherianum, Schottus states there is a hermetically sealed glass vessel half full of water, which had been sealed for fifty years, without the water becoming air. On the other hand, however, it appears that air can be produced, because, when a number of iron nails were placed in a mixture of oil of vitriol and water, Boyle found that a quantity of air was evolved, and, although this does not prove that water may become air, it proves, he considers, that air may be generated.

If, by any chance, Boyle had brought a candle near his newly-generated air, what a wide field would have been opened to him when he found that there were other airs differing from "the air;" but the possibility of there being different kinds of air does not seem to have entered his head; for even carbonic acid gas, although so totally different from ordinary air, was only distinguished by him as "thickened air."

Experiment 27. A watch was suspended by a thread in the air-pump receiver; on exhausting, the ticking ceased to be heard; but when air was re-admitted, it was heard as distinctly as before exhaustion.

A bell was supported in the receiver by a bent stick, the ends of which pressed against the sides of the receiver; when the latter was exhausted, and the bell rung, the sound was distinctly audible; hence Boyle concluded that sound can be conveyed by some rarer medium than air.

This is one of many examples of the great disadvantages under which the early experimenters laboured, and we must make every allowance for the false conclusions at which they sometimes arrived. When Boyle made this experiment, very little was known about the nature of sound; there were no previous experiments to tell him that the thread would not convey the vibrations to the receiver, whereas the stick would do so, and he, therefore, could have no reason for believing that there would be any difference in the result obtained, whether he suspended his sounding body by a thread or by a piece of wood, and yet perfectly contrary effects were produced, and be was thus led to a wrong conclusion.

Experiment 33 was made with a view of determining the pressure of air on a known area. The air-pump receiver was removed from the pump, and the piston forced to the top of the cylinder, the upper orifice of the latter (into which the shank of the stop-cock of the receiver fitted) being left open; weights were attached to the piston until it was drawn down. The piston was then forced to the top of the cylinder—the upper orifice of the latter closed—and weights were again attached until the piston was drawn down; the weights obviously represent the force necessary to overcome the pressure of the air, acting on the area of the piston + the force necessary to overcome the friction between the piston and pump barrel; the weight necessary to overcome the latter source of resistance having been previously determined, it was subtracted from the total weight, and it was thus found that 112 lbs. were competent to overcome the pressure of the air on the piston. The experiment was modified by drawing the piston to the bottom of the cylinder, against the pressure of the air, and seeing how much weight it would draw up—105 lbs. + the weight of the piston rod were raised.§

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[*] This experiment, as mentioned in the third of these papers, was tried by a different but far more complete method by Pascal; we must bear in mind, however, that his treatise "On the Weight of the Mass of Air" was not published till 1663, whereas Boyle's "Physico-Mechanical Experiments" appeared in 1661. Pascal undoubtedly made the experiment first, but Boyle was probably unaware of the fact.

[†] An account of some experiments made with the weather glass here referred to will be given in the next Number of this Journal.

[‡] From the German "dampf,"—vapour, steam, fume.

Experiment 34. Reasoning by analogy from the fact that two bodies of equal weight in air, but of different bulk, when weighed in water no longer balance each other, Boyle conceived that two bodies of equal weight in air would not be so in a vacuum. He, therefore, balanced on the opposite ends of a balance, capable of turning with $\frac{1}{32}$nd of a grain, a piece of cork and a piece of lead; the balance was placed in the air-pump receiver: on exhausting, the cork was found to preponderate, but on readmitting air, it continued to preponderate from some cause which Boyle was unable to discover.

Experiment 36. It is obvious, Boyle writes, that if we could place a balance above the atmosphere, or in a vacuum, we might weigh a quantity of air in the scales of the balance, just as we weigh substances in the air. In order to put this idea in practice, he procured a small "glass bubble," about the size of a hen's egg, and sealed it hermetically. It was then fastened to one end of the beam of the balance used in experiment 34, and was counterpoised by a piece of lead. The balance was placed in the receiver; on exhausting, the vessel of air greatly preponderated, and by placing weights on the other scale of the balance, so as to drag down the air-vessel, it was found that, in a vacuum, the air in the bubble weighed $\frac{5}{8}$ths of a grain. On one occasion, when the exhaustion had been continued for some time, the included air burst the bubble with violence.

Boyle here describes several experiments which he made in order to determine the relative weights of air and water. The determination had been previously made by several different methods. Galileo found water to be 400 times heavier than air; Ricciolus (by weighing a bladder of air in air),‖ 10,000 times; and Mersennus, 1356 times. Boyle's method was to heat a copper eolipile of known weight to redness, stop up the orifice with wax, weigh, perforate the wax to allow air to enter, and again weigh; the eolipile was then filled with water, and weighed. By this method water was found to be 938 times heavier than air.

Boyle next determined the relative weights of water and mercury, and found the latter to be $13\frac{28}{121}$ times heavier than the former. The relative weights of air and mercury were deduced from the above data, and were found to be as 14000 to 1. When in possession of these facts, Boyle was able to calculate that the height of the whole atmosphere, if we suppose it to possess throughout the same density as at the surface of the earth, would be seven miles; but, he writes, knowing as we do how readily air expands when pressure is removed from it, it is not improbable that the atmosphere may extend to a height of some hundreds of miles.

Experiment 37. Boyle frequently observed that when exhaustion was commenced the inside of the air-pump receiver became opaque, and that on the readmission of air the opacity disappeared. We now know this phenomenon to be produced by the deposit of minute particles of water, previously existing in the state of vapour in the air. The air in expanding performs work, and a certain amount of molecular motion is converted into mass motion; consequently, the aqueous vapour in the air is condensed. When air is readmitted, the particles strike against the sides of the receiver, and the amount of mass motion previously produced is reconverted into the molecular motion which produced it; consequently, the deposited water again becomes vapour.

Experiment 40. In order to see whether the rarity of the air in an exhausted receiver would prevent insects from flying, Boyle placed a bee and a fly in the receiver on exhausting, they both fell down "as in a swoon."

Experiment 41. A lark was placed in the receiver; on exhausting, it was seized with convulsions, and although air was quickly readmitted, it failed to revive. The pump had been worked ten minutes.

I have mentioned in the previous paper that the descriptions which Boyle gives of his experiments are exceedingly prolix; we have a good example before us in this experiment, which we should, in the present day, describe as above, but which Boyle, after telling us how he procured the bird, and how, when placed in the receiver, it did "divers times spring up in it to a good height," describes as follows:—

"The vessel being hastily, but carefully clos'd, the Pump was diligently ply'd, and the Bird for awhile appear'd lively enough; but upon a greater exsuction of the Air, she began manifestly to droop, and appear sick, and very soon after was taken with as violent and irregular convulsions as are wont to be observ'd in Poultry when their heads are wrung off. For the Bird threw herself over and over two or three times, and dyed with her Breast upward, her Head downwards, and her Neck owry. And though upon the appearing of these convulsions we turn'd the stopcock, and let in the air upon her, yet it came too late; whereupon, casting our eyes upon one of those accurate Dyals that go with a Pendulum, and were of late ingeniously invented by the noble and Learned Hugenius, we found that the whole Tragedy had been concluded within ten minutes of an hour, part of which time had been imploy'd in cementing the cover to the Receiver."

We must certainly give Boyle credit for being an accurate observer, and an experimenter who did not pass over the most minute occurrences without mention; but conceive what a memoir would be in the present day if it were spun out like the above account of one experiment! Why, the Royal Society would have to publish folios, and the *Philosophical Magazine* would become a thick quarto, and it would require half a lifetime to master one branch of science.

After the success of the lark experiment, Boyle placed a sparrow and a mouse in the receiver. On exhausting, they both died. In order to see whether death was produced by the "steams" from the lungs stifling the animals or from want of air, a mouse was enclosed in a large receiver. At the end of several hours it was alive and well, but died when the receiver was exhausted, proving that want of air was the cause which had produced the previous deaths.

Boyle here enters into a discussion as to the nature of Respiration. Many of the philosophers of his time believed that the sole use of respiration was the cooling and tempering the heat of the heart and blood; and this theory was not only admitted by several of the ancient writers, but by the Cartesians and numberless learned men. But, Boyle answers, fishes and frogs, and "divers cold creatures," have need of respiration; and in the above-mentioned experiments, in which animals were killed in rarefied air, it did not appear that the interior of the receiver was hotter than the external air.

Some believed that air passes from the lungs to the left ventricle of the heart, both to reduce its heat and "to generate spirits." Mœbius and Gassendus believed that the real use of the air in respiration is to ventilate the blood in its passage through the lungs, in which passage impure vapours are given off by the blood, and are removed by the air.

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§ The diameter of the piston was three inches; hence its area = 7·0686 square inches. The pressure of the air upon it would, therefore, be, in round numbers, 7·0686 × 15 lbs. = 106·020 lbs.

‖ It is obvious, as mentioned in the first of these papers (Chemical News, vol. viii., p. 115), that a bladder of air, weighed in air, weighs no more than the empty bladder.

According to Boyle, the use of air in respiration may be explained by two methods; for, first, just as a flame is stifled when burnt for some time in a close vessel by the "fuligenous steams" which it generates, so the vital fire of the heart may require fresh air to prevent it from being extinguished; or the air in the lungs may admit into its pores the impure vapours of the blood and remove them from the lungs. "We know," he continues, "that air too much thickened is unfit for respiration, because in the lead mines of Devonshire 'damps' sometimes arise which extinguish candles and suffocate the miners. Also, in cellars in which a large quantity of new wine is set to work, men have been suffocated on account of the great thickness of the air."

That the air is "thickened" by respiration Boyle proved by enclosing a bird in a small closed vessel. After three-quarters of an hour the air was found to be unfit to support life; and we can quite understand that the air must be thickened, he says, if we admit, with Sanctorius, that the quantity of matter which leaves our bodies by "insensible transpiration" exceeds in weight everything else which is given off from the body.

Air too much "thinned" is also unfit for respiration, as was proved by the death of the animals in an exhausted receiver; and Acosta states that he found some difficulty in breathing on the summit of a very lofty mountain in Peru.

Although Boyle is inclined to believe that one of the uses of air in respiration is to purify the blood, by removing the vapours which it throws off during its passage through the lungs, yet he conceives that it plays some other part; and Paracelsus ¶ had a similar idea, for he affirms that just as the stomach assimilates a certain amount of the meat we eat, and rejects the remainder, "*so the lungs consume part of the air, and proscribe the rest.*"

Cornelius Drebbel, ** also believed that only a certain portion of the air is consumed in the lungs, and it was reported that he had actually discovered that portion. It had been confidently stated to Boyle that Drebbel constructed a vessel for James I. capable of carrying twelve rowers and several passengers beneath the surface of water, and that, so soon as it was apparent that the air in the vessel had become impure from respiration, Drebbel removed the stopper from a bottle, filled with some liquid, which, by its evaporation, quickly rendered the air pure, and suitable for the purposes of respiration. This fact had been mentioned to Boyle by the friend of a man who had travelled in the vessel, by several relations of Drebbel's, and by a physician who married his daughter.

Experiment 43. When water, wine, or oil of turpentine were heated to ebullition, and placed in the air-pump receiver, the boiling recommenced on exhausting, and continued for some time; but hot salad oil could not be made to boil.

With this experiment Boyle concludes his letter, first apologising to Lord Dungarvan for not relating a larger number of experiments, many of which he had thought of and had wished to try, "were it not," he writes, "that my Avocations are grown so urgent for my remove from the place where the Engine was set up, that I am put to write your Lordship this Excuse, Weary, and in an Inne which I take in my way to my Dearest Brother Corke."

The account of the forty-three experiments detailed by Boyle in the treatise we have been considering, extends over 207 pages; but this may well be imagined from the extract given above from experiment 41.

In this first of Boyle's Pneumatic Treatises, there are an immense number of recorded facts; and when we remember the great difficulty of carrying out the experiments, we cannot too highly praise the industry and perseverance of their author. It is difficult for us, with our improved philosophical apparatus, to conceive the amount of labour attendant on the trial of experiments 200 years ago, when the few instruments which existed were to a greater or less extent imperfect. In the present day, if we wanted to make the last experiment mentioned above, we should place our vessel of hot water on the air-pump plate, cover it with a receiver, work the pump for a few minutes, and the experiment would be finished. In order to try the same experiment Boyle had to suspend a vessel of hot water in the receiver of his air-pump, and to cement on the cover of the receiver, and, while an assistant worked the piston, to alternately open the stop-cock of the receiver, close it, open the lateral valve, close it, again open the stop-cock, and so on, till the exhaustion was as complete as it could be; the whole apparatus was meanwhile shaken with every stroke of the pump, and leakage of air at the rather numerous joints was perpetually occurring.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

The British Pharmacopœia.

I.—The Novelties in the Pharmacopœia.

In commencing our notices of this important publication, we believe that we shall best serve the interest of our pharmaceutical readers by first of all giving a short account of the new compounds and preparations introduced, leaving a detailed criticism of the processes to a future occasion. The accounts will necessarily be short, as they are merely intended to give the pharmaceutist notice of the novelties with which it will be necessary to provide himself.

The first we come upon is under the head *Acetum*, where we find that vinegar made from French wine is to be used in place of vinegar made from malt. This preparation is a common article of commerce, but much that is sold under the name in this country is merely a dilute acetic acid, coloured and flavoured. It is here described as of a "straw colour," and is said to have a specific gravity ranging from 1·008 to 1·022.

Acidum Aceticum Glaciale is also a novelty to English pharmaceutists, although it was included in the last Dublin Pharmacopœia. This also is well known in commerce, being largely used by photographers. The best test of its strength is its solidifying when cooled to nearly 32° F.

We may here anticipate a remark we should have to make hereafter respecting the process given for the preparation of *Acidum Hydrochloricum*. Elaborate directions are given for mixing the materials and connecting the apparatus, but the writers have forgotten to mention that heat is to be applied to the mixture, so that, if the process be followed literally, very little, if any, hydrochloric acid will be obtained. This is a singular oversight of the compilers.

¶ Born 1493. Died 1541.

** Born 1572. Died 1634.

Acidum Sulphurosum.—Sulphurous acid has long had a limited use in medicine, though not in the Pharmacopœia. The acid ordered is a saturated solution of the gaseous acid in water, which has the sp. gr. 1·04.

Aconitia—aconitine.—A practicable process for the extraction of this alkaloid is given, but, as few will take the trouble to prepare it, we must once more caution our readers that the alkaloid made in this country only is to be relied upon. The article imported is, for the most part, worthless.

Ammoniæ Benzoas, benzoate of ammonia, is a salt well known to most of our readers. It has been but little used in medicine, but its introduction to the Pharmacopœia will no doubt increase the demand.

Ammoniæ Phosphas, phosphate of ammonia, is another novelty of which it is not necessary to say anything.

Antimonii Oxidum, the teroxide of antimony, is now used in the preparation of *pulvis antimonialis,* as it is now again called, or the *pulvis antimonii compositus* of the late Pharmacopœia. Pulvis antimonialis is now ordered to be made by the simple mixture of one part of the above oxide of antimony and two parts of precipitated phosphate of lime. This is, in one sense, an improvement, since a definite compound will always be obtained.

Antimonium Sulphuratum is the name now given to the tersulphuret of antimony.

Antimonii Terchloridi Liquor has also been added to the materia medica, since the above-mentioned oxide is ordered to be prepared from this solution by precipitating the oxichloride with water, and subsequently treating this precipitate with carbonate of soda.

Antimonium Tartaratum is the new name for the potassio-tartrate of antimony, a very simple mode of making which is now given. It consists simply in first mixing oxide of antimony and bitartrate of potash with sufficient water to form a paste, and allowing them to stand for twenty-four hours, and then boiling with more water for a quarter of an hour. The chemistry of this process will not perplex medical students, as older methods did; and examiners at the "Hall" will be deprived of a pet question.

Arnica, the root of the arnica montana, is used in the preparation of a tincture.

Atropia is employed in a liquor and an unguentum; the former in the proportion of four grains with one drachm of spirit and seven drachms of water, and the latter with eight grains of atropia to half a drachm of spirit and an ounce of lard.

Beberiæ Sulphas, sulphate of beberine, has been for some years a common medicine, and is probably well known to most of our readers. So also is

Bela, Indian bael, of which a form for a liquid extract is given.

Bismuthum Album is the new name for nitrate of bismuth, which is now prescribed in the form of lozenges, each of which is to contain two grains of the white bismuth, together with some carbonate of magnesia and carbonate of lime.

Several lozenges are prescribed in the Pharmacopœia; but as the preparation of these in an elegant form requires special appliances and some skill, the business will necessarily pass into the hands of the regular lozenge manufacturers, on whom the majority of pharmaceutists must rely for these articles.

Bucco is our old familiar friend buchu, of which a tincture as well as an infusion is now ordered.

Calcis Carbonas Precipitata is the article long in use for tooth powder, and now ordered to be used in the preparation of mistura cretæ.

Calcis Phosphas Precipitata is the phosphate of lime precipitated by ammonia from bone ash dissolved in hydrochloric acid. It is used, as mentioned above, in making pulvis antimonialis.

Calx Chlorata is the abbreviation now used for calx chlorinata.

Cannabis Indica now finds a place in the Pharmacopœia. An extract and a tincture are ordered, the tincture being made by dissolving an ounce of the extract in a pint of rectified spirit.

Carbo Animalis Purificatus, instead of being prepared from bullock's blood, is now intended to be bone black deprived of mineral matters by digestion with hydrochloric acid.

Chirata.—Chiretta is now officinal, and is used in a tincture and infusion. The infusion is made with a quarter of an ounce to ten ounces of water at 120°, and is to stand half an hour. The tincture is made with two ounces and a-half to one pint of proof spirit.

Chlori Liquor, a solution of chlorine, is another novelty here. The gas from six ounces of hydrochloric acid with an ounce of oxide of manganese is washed with a little water, and then passed into thirty-two ounces of distilled water. It is directed to be kept in a green glass bottle, well stoppered, and in a cool, dark place. It ought not, however, to be kept many weeks.

Cocculus, cocculus Indicus, is now used in the form of an ointment. Eighty grains of the seeds are to be well beaten in a mortar, and then rubbed with an ounce of lard.

Collodium is to be made by dissolving an ounce of gun cotton in thirty-six ounces of ether and twelve ounces of spirit.

Confectio Piperis we may mention as a new preparation, since it differs considerably from the old confectio piperis. It is now simply black pepper two ounces, carraway powder three ounces, and clarified honey fifteen ounces.

Conii Fructus.—Tincture of conium is now directed to be prepared with hemlock fruit instead of the dried leaves. Two ounces and a-half of the bruised fruit are to be macerated for forty-eight hours with fifteen ounces of spirit, and then percolated. When the fluid ceases to pass, the remaining five ounces of spirit are to be poured into the percolator. When the percolation is completed, the contents of the percolator are to be pressed, and proof spirit added to make up the pint.

Conii Succus is to be prepared from the fresh leaves, which are to be bruised and pressed, and one part of rectified spirit added to three parts of juice.

Creasotum.—A mistura creasoti is now ordered. The form is as follows:—Creasoti, sixteen minims; glacial acetic acid, sixteen minims; spirit of juniper, half a fluid drachm; syrup, an ounce; water, fifteen ounces. Mix the creosote and acid, then gradually add the water, and afterwards the syrup and spirit of juniper.

Crocus.—A tinctura croci, an ounce to a pint of proof spirit, is directed to be made by maceration and percolation, as in the case of the tinctura conii fructus.

Cusso means Kousso, ordered in the form of an infusion, the directions for the preparation of which would be enigmatical if the thing were not well known. The Pharmacopœia says:—"Take of kousso, in coarse powder, a quarter of an ounce; boiling distilled water, four fluid ounces. Infuse in covered vessel for fifteen minutes without straining." It is meant that the powder shall be swallowed, without which, we take it, the infusion would be of very little use.

Digitalinum is the active principle of fox glove, a process for making which is given. As most druggists must rely on the manufacturers for such articles as this, we need not at present notice this process, which otherwise possesses some interest.

Fel Bovinum Purificatum is ox gall purified by mixing it with rectified spirit, allowing it to stand for some hours, decanting from the sediment, and evaporating to a proper consistence.

(To be continued.)

PHYSICAL SCIENCE.

On the Spectrum of Thallium, by WILLIAM CROOKES, *F.R.S.*

THE present number contains a translation of a paper recently communicated to the Académie des Sciences by M. J. Nicklès.[*] The statements in it are so extraordinary, and so entirely at variance with the results of my experience, that I have been induced to try several experiments with the view of ascertaining whether I could detect any action of the kind there detailed.

M. Nicklès says that certain sodium compounds possess an antagonistic action to the green thallium line in the spectrum, that chloride of sodium especially has the property of obscuring the green ray, and that sodium compounds possess a paralysing action on the green thallium light. It is evident that M. Nicklès does not here allude to the obvious action which all coloured flames possess, when of sufficient intensity, of masking minute traces of other coloured light. There is no need to write a paper to explain that a large excess of salt on the wick of a spirit lamp will hide traces of thallium green in the same flame when seen with the naked eye; but the statement, that these two flames, when mixed, are incapable of resolution in the spectroscope, is one which must not be accepted without the most positive and unmistakable evidence. I know not whether there are thallium compounds which do not possess the property of developing the green spectral ray. I have not yet met with such compounds; and the following experiments show that the green line possesses too much vitality to be killed by any reasonable excess of chloride of sodium.

As recommended by M. Nicklès, an excess of a saturated solution of chloride of sodium was poured into a solution of acetate of thallium. The precipitated chloride of thallium was filtered off, and the clear liquid was tested in the spectroscope, a fraction of a drop being taken up on the end of a platinum wire bent into a loop. As soon as the moistened end was brought into the flame, a brilliant evolution of the yellow sodium band was observed, accompanying which was an almost equally brilliant flash of the thallium green line, lasting about half a second, and then suddenly vanishing. This is characteristic of most thallium compounds when present in small quantities. They are so volatile above a red heat, that the line partakes more of the character of a flash than a glow. Chloride of thallium is especially volatile, and it dissolves so slightly in cold water, or in solution of chloride of sodium, that it is difficult to get by means of the spectrum stronger evidence of its presence in water than is afforded by a momentary flash of green.

I next took two platinum wires looped at the ends. One of them had a bead of chloride of sodium fused on to it, whilst the other was dipped into a saturated aqueous solution of chloride of thallium. The thallic wire was introduced into the flame, and the brilliancy and duration of the green flash noticed. The bead of salt was next held in the flame; and whilst the whole of the apparatus was brilliantly illuminated with the intense yellow rays, and the field of the telescope was very bright, owing to irradiation round the yellow line, the other wire was dipped into the solution of chloride of thallium and brought into the flame. In spite of the dazzling light given out by the ignited salt, the green line was just as intense as when no salt whatever was present.

A piece of thallium wire, about six inches long, and weighing one grain, had the fiftieth of an inch cut from one end; the small fragment weighed, therefore, about the 300th of a grain. This was taken up on the end of a platinum wire, and the two were melted together. The end was now bent into a loop, and introduced into the flame of the spectroscope. The green line in this case appeared as a continuous glow, lasting, with little variation of intensity, for a considerable time. Whilst observing the line, a bead of chloride of sodium was brought into the flame, and after a few seconds removed, this being repeated two or three times, and careful notice being taken whether the green line suffered any diminution of intensity. No alteration whatever was apparent, allowance being made for the seeming slight diminution of brightness caused by the brilliant illumination of the field of the telescope.

The alloyed end of the platinum wire (from which most of the thallium had by this time been burnt away) had, as nearly as possible, half a grain of chloride of sodium melted on to it, and it was then again introduced into the flame of the spectroscope. The thallium, in this case, was burnt in the presence of nearly a thousand times its weight of chloride of sodium; here, if at all, the paralysing action of sodium should be apparent; but I could not detect the least interference whatever between the two lines, which glowed side by side in total indifference as to each other's existence.

I consider these experiments conclusive; and more accurate details of the conditions under which the thallium line is destroyed by sodium, are required before such an extraordinary statement can be admitted as correct.

Note on the Spectral Ray of Thallium, by M. J. NICKLES.

I HAVE found that there are thallic compounds which do not possess the property of colouring flames green, nor of developing the characteristic spectral ray; these are compounds containing sodium, especially chloride of sodium. By its flame and its yellow rays, this chloride completely hides the green line.

If chloride of thallium is insoluble in cold water, it is not so in water saturated with chloride of sodium. For instance, on pouring this latter into acetate of thallium, a precipitate of chloride of thallium is formed; but the mother liquors contain a notable quantity of the latter without being able to colour the gas flame *green*.

If, therefore, amongst the rays of the solar spectrum the characteristic one of thallium has not been observed, this does not by any means prove that this metal does not exist in the sun, as has been supposed; for if it has not been proved to be present, soda has been found, and the object of this note is to make known the paralysing action of this metal when present in a certain proportion.

This incompatibility between the thallium and sodium rays should also be taken into serious consideration in toxical or medico-legal researches; for when it is in combination with liquid or solid animal matter, soda may likewise be present, and in sufficient quantity to nullify its action on the flame, and thus seem to show the absence of this poisonous metal.

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[*] *Comptes Rendus*, lviii., 132.

At the same time, if it be desirable to look for this interesting simple body in mineral water, mother liquors, and generally all saline waters containing an excess of chloride of sodium, it is necessary to begin by separating it first from the excess of soda, either by reducing it with pure zinc, or by extracting it with a battery; or, lastly, by precipitation with sulphide of ammonium, or iodide of potassium.

With reference to this last, I find that liquids containing chloride or bromide of thallium in solution are precipitated by iodide of potassium, producing iodide of thallium of a beautiful yellow colour, insoluble in the precipitating iodide, but tolerably soluble in distilled water.—*Comptes-Rendus*, lviii., 132.

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture IV.—*Saturday, December* 19, 1863.

Ladies and Gentlemen,—In the last lecture we entered upon the subject of carbonate of lime, and considered the varieties of that compound occurring in nature. There are, you will remember, three: the amorphous state of carbonate of lime, represented by chalk; the prismatic crystalline state, represented by arragonite; and the rhombohedral, represented by calcite. We then proceeded to examine the conditions under which arragonite and calcite are respectively formed; and I think you must all have been struck with the remarkable facts which have been discovered by Rose with respect to this subject. We have seen that apparently the most trifling alterations in respect of dilution and of temperature are sufficient to determine the crystallisation of carbonate of lime in one or other of those forms—facts which are, apparently, insignificant in themselves, but in relation to geology may have an important bearing, as indicating the precise conditions which may have obtained in former periods where we discover the presence of those bodies.

At the beginning of the last lecture I called your attention to a curious illustration founded on experiment by Deville; and, as I do not appear to have made myself clearly understood, perhaps you will allow me a minute or two to explain it again. I say this, because I have been asked questions upon the subject which clearly prove that I failed to render myself as intelligible as I ought to have done. The experiment relates to an interesting mineral termed "staurolite." I sketched rudely a diagram representing a tube containing successive layers of alumina and silica. I then supposed that this tube was heated. I will draw it horizontally this time, so as to make it perfectly clear. You pass the gas in at one end. We have here in one compartment alumina, then silica, then alumina, then silica again. The gas we pass through is a compound of fluorine and silicon. The mineral that we want to form is a compound of silica and alumina—a silicate of alumina in fact. Fluoride of silicon—that is, fluorine and silicon—enters the tube previously heated. The change that takes place in the first segment, or partition, here represented, is this: some of the aluminium is removed, and combines with the fluorine, and passes over as fluoride of aluminium, whilst a corresponding or equivalent amount of the fluoride of silicon is there deposited, forming the mineral in question. The gas which enters is fluoride of silicon; the gas which leaves the first apartment is fluoride of aluminium. This then acts upon the silica, and a corresponding change takes place in the next partition. The aluminium is deposited, and the silicon escapes in conjunction with the fluorine. Then we have the fluoride of silicon acting upon the aluminium; then the fluoride of aluminium acting again upon the silicon, and so forth; so that with a small definite amount of fluorine you are able in this way to convert an indefinite quantity of alumina and silica into the mineral in question. It is not pretended that a process identically the same as that which I have been describing is actually occurring, or has occurred in nature; but it is remarkably illustrative, as showing the possibilities, at all events, of the formation of minerals of this kind. I hope I have now succeeded in rendering that plain which I had left obscure on a former occasion.

In regard to the source of lime in nature, you find lime everywhere. In almost all the so-called Plutonic rocks lime exists. It is there in combination with silica, as a silicate of lime; and the silicate of lime may be easily extracted from these rocks by the solvent action of water, especially water containing carbonic acid. One of the most remarkable and highly calciferous minerals with which we are acquainted, is the well-known labradorite, or calciferous soda felspar, containing 15 or 16 per cent. of lime, which is the maximum, and 6 per cent. of soda. Of all such calciferous rocks, perhaps this is the most easily decomposed by carbonic acid; and, therefore, there is no difficulty whatever in accounting for the extraction of lime from this rock by ordinary atmospheric influences. Woollastonite, or tabular spar, which is a silicate of lime in which the oxygen of the silica is exactly double that of the base, may also be decomposed by water containing carbonic acid. This may be a source of lime. There is no difficulty whatever, in fact, in accounting for the extraction of lime from those rocks which contain it, and which are supposed to have been developed by igneous agency. I will show you presently, when I speak of silicates, a specimen of woollastonite artificially prepared last night at a high temperature. It is one of the best I have seen. I have often made it in small crystals; but here it is in very distinct crystals, prepared by fusing the lime and the silica at a high temperature.

We next pass on to the examination of a remarkably interesting mineral, and one which is highly instructive in its geological bearings, namely, fluor spar; that beautiful mineral constituting the well-known ornamental objects which we see in various establishments, and having the common name of "blue John." Fluor spar is certainly one of the most interesting minerals with which we are acquainted. It crystallises in the cubical system, and occurs in various modifications of that system. Some of these varieties are remarkably phosphorescent. I have one such before me, called chlorophane. I am afraid almost that the light here will be too intense to enable you to see it at any considerable distance; but I think I shall be able to get evidence enough of the development of light to illustrate the fact, at all events. It somewhat decrepitates on heating. I have placed some of this fluor spar on the end of a piece of platinum, and you can already perceive distinctly the green light which it emits, and which will shortly become still more conspicuous. This is a remarkably fine specimen; and I regret that I cannot present these illustrations on a larger scale. That, however, would be utterly impossible; so we must content ourselves with these very small exhibitions of the fact. Fluorine is widely diffused in nature; in fact, fluorine may be said to exist everywhere, even in animal structures. Fluor spar contains exactly 48·53 per cent. of fluorine, the rest being the metal calcium; its specific gravity is, as nearly as may be, 3. It ranges from 3·017 to 3·188. Now, with respect to its solubility. This is a point of chief importance in regard to geological influences concerning fluor. The late Dr. Wilson, of Edinburgh, found that carbonic acid passed through water containing finely suspended fluor dissolved so much that he could, without difficulty, detect the presence of lime in that water by the ordinary reagent—oxalate of ammonia. We see, then, that fluor spar is sensibly soluble in common water by the agency of carbonic acid, and not only so, but the fluor spar is actually soluble to a certain extent—to a very limited extent, it is true—in pure water. He found that one part of fluor spar dissolved in 26923 parts of pure water; and the solubility of it was somewhat increased by heat. Fluor spar and silica may coexist dissolved in water; but no silico-fluoride of potassium is ever formed under these conditions. The fluor spar is partially decomposed by a hot aqueous solution of an alkaline carbonate with the formation of alkaline fluoride and carbonate of lime; and this decomposition may possibly occur in hot alkaline mineral waters where fluor spar may be present. Fluor spar was obtained crystallised by Senarmont at 250° centigrade during sixty hours. The experiment was made by heating recently precipitated gelatinous fluoride of calcium—a salt easily made by double decomposition in the laboratory of the chemist. By heating that in a sealed glass tube at 250° centigrade, during sixty hours, with a solution of an alkaline bicarbonate, and also with the insertion of a little bulb containing hydrochloric acid sufficient to act upon the bicarbonate, and to evolve carbonic acid, he succeeded in obtaining the fluor spar distinctly crystallised. There is no necessity, I take it, for supposing the existence of a high temperature during the formation of fluor spar under natural conditions. We have seen just now that the fluor spar is soluble, not only in pure water, but still more so in water containing carbonic acid, which everywhere occurs in nature. And this cause is quite sufficient of itself to enable us to explain the formation of these beautiful and magnificent crystals of fluor spar, which we meet with in mineral lodes. Time is the great element; but what is time in a geological sense? A thousand years is hardly as one day; and, when we have to deal with these enormous periods, there is no difficulty at all in accounting for the formation of those magnificent minerals by the slow, yet certain, operations of nature. Now, with regard to the influence of heat upon fluor spar: this is a point of considerable consequence. It may be supposed by some that fluor spar might have been injected in a molten state into mineral veins; but I believe there is no instance in which it can be shown that, where fluor spar exists to any great extent in mineral veins, the veins themselves have presented any indication of igneous action. Still, it is by no means impossible; for we find that fluor spar can be fused, and rendered perfectly liquid, at a very high temperature. I have here the result of an experiment, which happens to have turned out remarkably successful. A piece of blue fluor was put into a platinum crucible, and then exposed to a very high temperature. It fused beautifully, and, as good luck would have it, there is a large cavity in the interior, and in that cavity you see protruding delicate octahedral crystals as distinct as possible. Dr. Wilson detected fluor in various rocks—for example, the Aberdeen and Peterhead granite, and various trap-rocks from the vicinity of Edinburgh. In fact, fluorine is everywhere; and almost every element of nature we shall find by-and-by, I suppose, to be everywhere—in minute proportions, it is true. It occurs in numerous minerals, especially various micaceous minerals, in pyrochlore, zircon-syenite, certain varieties of hornblende, topaz, pycnite, chondrodite, and, as we have seen, in cryolite also abundantly. Almost all, if not all, fluor (by fluor I mean fluoride of calcium) seems to be a secondary product, derived from minerals containing fluorine decomposed by the action of percolating water.

The pseudomorphs we meet with in mineralogical cabinets tell a very important story with regard to the formation of fluor, and also other mineralogical specimens which are too apt to be despised by many persons. Many most interesting, though unattractive, specimens to the eye, capable of telling a wonderful history with regard to their formation, we have seen rejected as not being particularly good in point of formation of crystals, or not fine in the dealer's sense. Specimens which are looked upon with contempt are often in the highest degree instructive. With regard to these pseudomorphs, we find that one in particular, to which I wish to direct your attention, is by no means of uncommon occurrence—namely, the pseudomorph quartz. We find sometimes large crystals of fluor spar coated beautifully with quartz, or, in fact, presenting a cube of quartz, the fluor spar having been more or less—sometimes completely—removed, thus showing that the solvent action, whatever it may have been, which was capable of removing fluor, was not capable of acting upon the quartz. This, then, may furnish us with a very interesting indication with regard to the agents concerned in producing these forms. In further proof of the aqueous origin of fluor, I might mention the fact, that fluor crystals are sometimes—nay, not very unfrequently—found to contain water. Fluor spar has been found in the deposit of certain mineral springs—the Carlsbad springs, for example, where it was first detected by Berzelius. From those springs, according to Bischoff, who has made the calculation, the quantity of fluor spar extracted naturally, and naturally deposited, is supposed to be 24,700 lbs. Hence, as he said, there is no difficulty in the lapse of ages in accounting for the formation of considerable accumulations of fluor spar even from this source.

I might say a great deal more about the compounds of lime; but I am afraid I must draw to a close with these observations upon fluor, and proceed at once to the subject of magnesium. The metal magnesium forms the base of the well-known magnesia. It is only lately that we have been able to separate these metals from their bases in anything like respectable proportions; and now magnesium bids fair to become an article of commerce like aluminium. It is a metal similar in appearance to aluminium—whiter in point of colour. It is a remarkably light metal—lighter even than aluminium. It is malleable, and can be hammered or rolled out like aluminium. It can be drawn out into wire; and recently a process has been adopted for its extraction on a large scale; so that now we may have magnesium by the pound. It has a strong affinity for oxygen at a high temperature. Although, as was the case with aluminium, it requires an extraordinary amount of force to separate the magnesium from its combination with oxygen, yet, when separated, it is remarkable how stable the metal is at the ordinary temperature of the air. If, however, we apply heat, it will take fire, combining with oxygen, and producing a wonderfully intense light. It can be used with advantage for photographic purposes. I think you will be able to see distinct evidence of this. Only imagine a globe of magnesium surrounded with an atmosphere of oxygen burning for ages, and producing a light as bright as that of the sun!

Magnesia consists of one equivalent of the metal magnesium and one of oxygen. It is largely diffused in nature, where it exists in combination with carbonic acid, and it also exists very extensively in combination with silica, as we shall see hereafter.

But the carbonate of magnesia is the salt especially to which I have now to direct your attention. I have produced here in this glass case a quantity of magnesia, just to give you an idea of what it appears like by the precipitation of magnesia from common Epsom salts in the ordinary way—by carbonate of soda. Carbonate of magnesia thus produced occurs as a white amorphous powder, perfectly non-crystalline. It may, however, be obtained crystallised, and when crystallised it is known under the term of magnesite. In nature it occurs both crystallised and amorphous; and, in some localities, carbonate of magnesia is found remarkably pure, and in large quantity. I recollect some years ago seeing some large glass works, where I think I may say I saw some hundreds, if not thousands, of tons of almost pure carbonate of magnesia, imported somewhere from Greece. It was employed in the manufacture of soda. I was wonderfully struck with the enormous quantity of it, and with the fact of the importation of carbonate of magnesia nearly chemically pure, for we examined it, and found scarcely a trace of impurity in it. It occurs also in various other localities, on the continent, and elsewhere. Carbonate of magnesia is thrown down in an amorphous state by precipitation from solution, and it may be obtained crystallised by the action of neutral carbonate of soda on sulphate of magnesia at a temperature of 160° centigrade. There it is at the ordinary temperature amorphous. But if precaution be taken to raise the temperature during the precipitation or afterwards, then you may have it distinctly crystallised, and it requires 160° centigrade to produce that effect. It occurs, massive, as I have said, abundantly, and crystallised, in various localities. With regard to the solubility of carbonate of magnesia in pure water: one part dissolves in 4006 times—say, in round numbers, 4000 times—its weight of water. And one part of magnesia dissolves in 742 parts by weight of water containing carbonic acid. Carbonate of magnesia exists dissolved in sea-water. In the water of the ocean between Belgium and this country, Bischoff found one part dissolved in 6060 parts of water. There is, therefore, in sea-water a copious source of carbonate of magnesia. Carbonate of magnesia is decomposed at a low temperature by heat—in fact, at a much lower temperature, I believe, than carbonate of lime, and this is a point of considerable interest. One or two manufacturing processes have actually been founded upon this fact. If you take carbonate of lime—limestone, and heat it in a close retort, for reasons assigned on a previous occasion, you will not find carbonic acid liberated—not at all easily except at a pretty high temperature, and then not easily, unless some other gas than carbonic acid gas—the vapour of water, for example—is passed over it. This is not the case with carbonate of magnesia. It decomposes, as I said just now, at a comparatively low temperature, so that when you have a double compound of carbonate of magnesia and carbonate of lime known as dolomite, to which I shall presently direct your attention, and heat that in a close vessel at a low temperature, carbonic acid distils off from the magnesia easily and may be collected, leaving the carbonate of lime almost unchanged. That is an important point in reference to geological matters, as we shall see hereafter. This fact is not generally known. A patent was taken out for the process a good many years ago. I saw it myself in operation nearly thirty years ago. The carbonic acid produced was intended to be applied in the manufacture of carbonate of sodà. It is a curious point, that although the dolomite was apparently very pure and free from organic matter, there being no trace of organic matter to the eye in the dolomite that was employed, yet the quantity of offensive gas resulting from the destruction of some invisible organic matter in that dolomite, rendered the process eventually unserviceable, and it was abandoned in consequence. No doubt, if such a piece of dolomite were examined by the chemist in his laboratory, he would fail to detect the presence of organic matter in it; but when we operate upon a large scale, we get decisive results, which we fail to obtain on a small scale. The fact is worthy of note, as showing that even dolomite which appears to be perfectly pure, free from the contamination of organic matter, may yet contain it in sufficient quantity to render the carbonic acid liberated from it when heated, exceedingly offensive by its odour,—for the odour could only have arisen from the presence of organic matter.

With regard to silicate of magnesia, it occurs abundantly in nature. It is slightly soluble in water, but I do not find that the degree of solubility has been exactly ascertained. Here is a point to be noticed. Silicate of lime, we have seen, is decomposed easily enough by carbonic acid and water. Even when the silicate is simply mechanically suspended in the water, it yet may be decomposed by the carbonic acid. According to Bischoff, this is not the case with silicate of magnesia. This point may be exceedingly important in its geological relations. Silicate of magnesia, according to him, cannot be decomposed by carbonic acid when merely suspended in water. It must be actually dissolved therein to suffer decomposition by this acid.

(To be continued.)

ACADEMY OF SCIENCES.

January 18, 1864.

M. Damour communicated a note "*On the Density of Zircon.*" This has been found to vary between 4·04 and 4·67. The author found that by calcination at a white heat the density increased from $\frac{1}{16}$th to $\frac{1}{12}$th. He infers that the specific gravity of the mineral depends upon its molecular state. The infusibility of zircon is remarkable. M. Damour could only fuse a thin layer of the surface by using the oxyhydrogen blow-pipe.

M. Pisani presented an analysis of an aërolite which fell near Louvain on December 7, last year. The density of the stone was 3·525. It was composed of—

Iron, with nickel, tin, and traces of phosphorus	8·67
Iron pyrites	6·06
Chromated iron	0·71
Silicates	84·28
	99·72

The silicates appear to have been a mixture of augite and felspar.

A note by M. Maumené "*On the Artificial Preparation of Pure Oxalic Acid,*" was presented.

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(tenth notice.)

(Continued from page 46.)

The first of the organic products mentioned in the Report is oxalic acid, and the greatest novelty in connexion with this article since 1851 is the manufacture from sawdust, which naturally occupies some space in the report. A well-merited compliment is here paid to the enterprise and skill of Messrs. Roberts, Dale, and Co., of Manchester, who have perfected this and many other industrial processes. Gay-Lussac so far back as 1829 showed that oxalic acid was produced when sawdust was heated with caustic potash; and later, M. Possoz announced that this effect was more easily produced when a mixture of potash and soda was employed, than when either alkali was used alone. It remained, however, for Messrs. Dale and Co. to make it an industrial process. That they have succeeded the market price of oxalic acid sufficiently shows. In 1851 the price was 15d. or 16d. per lb.; it is now 8d. or 9d.

The Report states that the manufacture will probably remain a monopoly, on account of the enormous amount of fuel required, an expenditure of forty tons of coal being necessary to produce one ton of oxalic acid. We give an outline of the process. A mixture of two equivalents of soda and one of potash in solution is evaporated to about 1·35 sp. gr. At this stage, sawdust is introduced as long as it will dissolve. The paste produced is placed in thin layers on iron plates, which are heated to about 250° C., and the paste stirred until the materials are perfectly dried, but without charring. About 28 to 30 per cent. of oxalic acid is thus obtained, which is separated in the following way:—The mass is treated with water heated to 15° C., in which all dissolves but the oxalate of soda, which, being but slightly soluble, falls to the bottom. The oxalate of sodium is then decomposed by boiling with hydrate of lime, and the resulting oxalate of lime is decomposed by the use of three equivalents of sulphuric acid to one of the oxalate. The solution of oxalic acid is run out, evaporated, crystallised, and purified. From two parts of sawdust one part of oxalic acid may thus be obtained.

Acetic acid is also made from saw-dust. The material is slowly delivered to the retort by means of a hopper, and the residual finely-divided charcoal is carried into a vessel of water. This method is not, however, considered very remunerative, and the distillation from split blocks is continued. A great improvement in this manufacture is that patented by Mr. Condy, who destroys the empyreumatic matters by a rectification with bichromate or permanganate of potash. A remarkably pure acid is thus obtained, which may be used for "fortifying" malt vinegar in place of the mineral acid which the law allows.

The use of the crude acid for the preparation of the acetate of iron, and other acetates for mordants, is without objection; but for other purposes a purer acid is required. This is obtained by converting the crude acid into acetate of soda, or acetate of lime, purifying these first by distillation to get rid of methylic spirit, and then, by heating, to char other foreign matters, and finally dissolving and recrystallising the salt, which is afterwards decomposed by sulphuric acid.

A process for the preparation of glacial or monohydrated acetic acid is here given, which we may quote at length, since the consumption of this article in England is likely to be increased by its introduction into the British Pharmacopœia:—

"Nearly twenty years ago, M. Melsens, a distinguished Belgian chemist, observed that ordinary acetate of potassium, when supersaturated with ordinary acetic acid, yields on evaporation an acid salt containing, according to his analysis,

$$KC_2H_3O_2,HC_2H_3O_2.$$

"The concentrated solution solidifies on cooling to a crystalline mass. The crystals of this salt may be heated *in vacuo* to 120° C. without losing weight. At 148° C. the salt fuses with loss of a minute quantity of acid; at 200° C. it begins to boil, evolving vapours of crystallisable hydrate of acetic acid; at 300° C. the retort contains neutral acetate of potash, which is decomposed only when the temperature is still further raised. M. Melsens expressed at the time the opinion that this observation might be utilised for the production of monohydrated acetic acid on a large scale. Indeed, if neutral acetate of potash be distilled with an excess of moderately dilute acetic acid, the salt fixes part of this acid, whilst another portion, more dilute, passes over. Gradually the concentration of the acid increases, and ultimately a point is reached when the distillate solidifies. It is necessary to keep the temperature below 300°, since the distillate becomes coloured and acquires an empyreumatic odour if the heat be increased beyond that point."

The manufacture of tartaric acid offers nothing of particular interest; but we may quote what the Reporter saw at the works of M. C. Kestner, at Thann. The method of separating tartaric acid there adopted is the following:—

"The crude tartar is dissolved in hydrochloric acid, which separates at once the greater part of the organic impurities, and also some colouring matters insoluble in hydrochloric acid. The solution is then precipitated by lime, and the tartrate of lime decomposed by sulphuric acid."

The purification is effected in the usual manner.

We come next to dyeing matters, which must necessarily occupy a larger space; and at this point we may mention that the collected reports of the juries are now issued in a 15s. volume. The Report we are noticing is not yet to be had in a separate form—at which we must once more protest—since it appears to us to be almost the only one worth purchasing.

Chemistry. By the late George Wilson, M.D., F.R.S. Revised and enlarged by Stevenson Macadam, Ph.D., &c., &c. (Chambers' Educational Course.) London and Edinburgh: W. and R. Chambers.

An Introduction to Chemistry; including a Popular Summary of Animal and Vegetable Physiology. London: Hardwicke.

The first of the above-named books may be said to be the best elementary work on chemistry ever published.

The second is one of "Hardwicke's Elementary Books," a very cheap series of works, intended by that enterprising publisher to spread a knowledge of scientific principles among the labouring classes. The series deserves a great success.

First Outlines of a Dictionary of the Solubilities of Chemical Substances. By Frank H. Storer. Part II. London: Trübner and Co. Cambridge (U.S.): Sever and Francis. 1863.

We have much pleasure in noticing the second part of this valuable work, which carries it on from "Convolvulinolic Acid" to "Protoxide of Tin." It is not necessary for us to say anything of the design and execution of the work; the following extracts will give our readers an idea of both:—

"Cyanide of Silver.—($AgC_2N = AgCy$.)—Insoluble in water, and in dilute nitric acid. (Fresenius, *Quant.*, p. 142.) Sparingly soluble in dilute nitric acid; more readily in boiling than in cold. (Thawlow). Unacted upon by other dilute oxygen acids. Decomposed by strong acids. (Ittner.) Not soluble to a perceptible extent in commercial cyanhydric acid. (Gore.) Soluble in aqueous solutions of the cyanides of ammonium, potassium, sodium, calcium, barium, and strontium.

"Very soluble in aqueous solutions of the cyanides of potassium and of sodium, of chloride of ammonium, and of hyposulphite of soda. (Gore.) Soluble in boiling aqueous solutions of the chlorides of potassium, sodium, calcium, barium, and magnesium; but at ordinary temperatures this solution takes place very slowly. Also soluble in solutions of hyposulphite of soda, ferrocyanide of potassium, carbonate, sulphate, nitrate, and succinate of ammonia, and in a large excess of a hot solution of chloride of ammonium. Soluble in ammonia water. (Wittstein.) Easily soluble in ammonia water, but is not decomposed by solutions of the caustic alkalies. (Berzelius, *Lehrb.*) Soluble in a strong boiling solution of nitrate of silver. (Wœhler.) Slightly soluble in an aqueous solution of citrate of soda. (Spiller.) Soluble in an aqueous solution of nitrate of protoxide of mercury, from which it is precipitated on the addition of cyanhydric acid, but it is not precipitated either by nitric acid or by a solution of nitrate of silver. (Wackenroder, *Ann. Ch. u. Pharm.*, 41. 317.) Easily soluble in ammonia water. Not decomposed by the fixed alkalies.

"Nitrite of Silver.—Very sparingly soluble in cold, more soluble in warm water, from which it is deposited as the solution cools. (Persoz, *Ann. Ch. et Phys.*, (3.) 23. 50.) Soluble in 120 pints of cold water; more soluble in hot water. (Mitscherlich.) Soluble in 300 pints of cold water. (Fischer.) Insoluble in alcohol.

"**Oxalate of Lime.**—($C_4Ca_2O_8 + 2$ Aq & 6 Aq.) Permanent. Almost insoluble in water; the presence of free acetic or oxalic acid increases its solubility slightly. It is soluble in strong acids. (Fresenius, *Quant.*, pp. 128, 772.) 'The solubility of oxalate of lime (in water) is $\frac{1}{500600}$.' (Malaguti, *Ann. Ch. et. Phys.* (3.) 51. 347.) Insoluble in water, acetic acid, or a solution of chloride of ammonium. (Scheele.) Insoluble in water, oxalic acid, or acetic acid. Easily soluble in chlorhydric and nitric acids. (Wittstein's *Handw.*) Even when recently precipitated, it does not appear to be soluble either in hot or cold aqueous solutions of chloride of ammonium (Brett, *Phil. Mag.*, 1837, (3.) 10. 96; Wackenroder, *Ann. Ch. u. Pharm.*, 41. 316) or of nitrate of ammonia. (Brett, *Ibid.*) Insoluble in aqueous solutions, even when these are hot and concentrated, of the chlorides of ammonium, sodium, potassium, barium, strontium, and calcium; on the contrary, it is easily soluble in hot, tolerably concentrated solutions of salts of the 'magnesia group' (*ex. gr.* of manganese, magnesia, &c.), from which solutions it is precipitated on the addition of an excess of oxalate of magnesia. Insoluble in solutions of the salts of oxalic acid. (Souchay & Lenssen, *Ann. Ch. u. Pharm.*, 100. 323.) Soluble in an aqueous solution of chloride of magnesium, from which it is precipitated, together with some magnesia, by an excess of oxalate of ammonia.

"Soluble in an aqueous solution of neutral citrate of soda. (Spiller.) In presence of much chloride of calcium, of sodium, or of ammonium, it is completely soluble in protochloride of copper (CuCl), but after a while oxalate of copper separates out. (Reynoso.) Slightly soluble in water containing chloride of manganese. (Turner.) Very sparingly soluble in oxalic acid. (Bérard.) Slightly soluble in lactic acid. (Cap & Henry.) Soluble in considerable quantity in strong phosphoric acid, especially when this is warm. This solution may be largely diluted with water without being precipitated. (Neubauer, *Ann. Ch. u. Pharm.*, 99. 223.) Insoluble in cold, concentrated nitric acid, decomposed when heated therewith, also decomposed by concentrated sulphuric acid. Tolerably soluble in chlorhydric and in slightly diluted nitric acid. From the saturated chlorhydric acid solution, portions of it are precipitated both on addition of oxalic acid and of chloride of calcium. (Gladstone.)

"Oxalate of lime is not precipitated when a neutral aqueous solution of oxalate of alumina is mixed with a neutral solution of the hyposulphite or nitrate of lime, or of chloride of calcium. (Herschel, *Edin. Phil. Journ.*, 1819, 1. 21.) Lime cannot be entirely precipitated by oxalic acid from solutions which contain sesquioxide of chromium, of iron, or of alumina, since double oxalates which are somewhat soluble in water, form in the mixtures. (Reece.) Insoluble in an aqueous solution of cane sugar. (Bergman, 'Essays,' 1. 318.)"

The above articles sufficiently testify to the value of the work to the practical chemist.

NOTICES OF PATENTS.

2552. *The Preparation of Colouring Matters from Aniline.* W. and W. H. Watson, Harrogate, Yorkshire. Dated September 17, 1862. (Not proceeded with.)

The inventors act upon aniline with half its weight of nitro-hydrochloric acid (aqua regia) at or about the temperature of 140° Fahr., whereby a mixture of colouring matters is gradually formed. For the separation of these the raw product is treated with water, which dissolves out the red dye, leaving a blue colouring matter and dark-brown resin insoluble. This residual portion is further treated with alcohol, in which it is completely soluble, and benzole added to the solution in the proportion of six times the bulk has the effect of precipitating the blue substance in a state of purity. This last product is then dissolved for use in alcohol or methylated spirit.

The directions given in this specification are practically identical with those described one month earlier by Mr. John S. Blockey, of Leeds.*

2604. *An Improved Composition for Painting.* R. A. Brooman, Fleet Street, London. A communication Dated September 24, 1862.

This paint is prepared by mixing together two distinct compositions, which are to be incorporated only at the time of using.

I. Liquid Compound.

Oxalic acid	65	parts.
Sugar, or other saccharine matter .	60	,,
Salts of tartar, or other carbonated alkali	100	,,
Soft soap	25	,,
Water	750	,,

II. Pigments, &c.

White lead, or zinc white . . .	125	parts.
Boiled linseed oil	125	,,
Driers, of any kind	500	,,
Litharge	50	,,
Soft soap	200	,,

It is preferred to use soap, which contains a certain quantity of an alkaline silicate, in admixture with the fatty ingredients. The zinc or lead white may be partially replaced either by chalk or sulphate of baryta.

2605. *Treating and Preparing Madder for Dyeing Purposes.* W. Maddick, Jun., Liverpool. Dated September 24, 1862.

The patentee's first claim consists in treating madder for dyeing purposes, after being ground, by damping or saturating with water, and then allowing it to stand for a period not exceeding twenty-four hours previously to being placed in the dyeing bath or beck. The second head of the invention refers to modes of applying the madder dye.

This fermentation treatment appears to be directed to the removal of the yellow colouring matter, which is usually destroyed by sulphuric acid.

2634. *Certain New and Improved Applications of Petroleum and its Products, certain Agents Produced by Combining the same with other Substances, and certain Modes of Treating Caoutchouc, Gutta-percha, and their Compounds and Substances similar thereto.* M. Henry, Fleet Street, London. A communication. Dated September 27, 1862.

This invention refers to the employment of American petroleum, or of native mineral oils from other sources, or of products obtained from these by distillation, for vulcanising caoutchouc, and for a variety of other manufacturing purposes. The liquid hydrocarbons proposed to be employed are the following:—First, a colourless liquid of ethereal odour, and specific gravity ·669, and boiling at the temperature of 154° Fahr. This product constitutes the chief bulk of the distillate obtained from American oil, and has been named the hydride of caproylene by Cahours and Pelouse. The second product has a boiling point of 203° Fahr., and the third liquid is a heavy oily body, distilling at about 320°. These hydrocarbons are employed as solvents either separately or in admixture.

2645. *Improvements in the Manufacture of Compounds of Silica, and in the Application of Certain Compounds of Silica to Mineralize Woven Fabrics, Paper, and Paper Pulp; to Harden and Preserve Stone and Cement; in the Production of Artificial Stone and Paint, and in the Glazing of Porcelain and such like Manufactures.* H. Ellis, Bangor, North Wales. Dated September 29, 1862.

The patentee manufactures a variety of compound silicates by first precipitating the metallic or earthy silicate in the ordinary manner by double decomposition between the silicate of an alkali and a soluble metallic salt; the product so obtained is collected on a filter and washed; it is then redissolved at once to saturation in a solution of silicate of soda or potash. If the gelatinous precipitate has been allowed to dry, it will require boiling with the silicate, in order to become completely dissolved. The addition of alkaline carbonates, borates, and phosphates, will facilitate the solution of the gelatinous silicates, and the double compounds so formed may be preserved in air-tight vessels until required for the purposes named in the heading.

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* Chemical News, vol. ix., p. 11.

2654. *Manufacture of Varnish, Printing Ink, Paint, and Printing Colours.* A. Prince, Trafalgar Square, London. A communication. Dated September 30, 1862.

This invention consists in the application of petroleum, or products distilled therefrom (instead of linseed oil), to the manufacture of varnish, printing ink, paint, and colours of every description. Instead of natural petroleum the oil distilled from coal and schist may be employed.

Grants of Provisional Protection for Six Months.

3213. William Henry Tooth, Rhodeswell-road, Stepney, Middlesex, "Improvements in the manufacture of iron and steel, and in the machinery, apparatus, and furnaces used therein, and for the production and application of gas to be employed in such manufacture, and the application of parts of the said apparatus to the manufacture of glass and alkali."—Petitions recorded December 19, 1863.

3037. Richard Archibald Brooman, Fleet Street, London, "Improvements in the distillation or treatment of bituminous substances."—A communication from John Saunders, New York, U.S.

3044. James Bowron, South Stockton, Yorkshire, and George Robinson, Welbeck Street, Cavendish Square, London, "Improvements in the manufacture of soda and sulphuric acid."—Petitions recorded December 3, 1863.

3080. George Charles Grimes, Wandle Terrace, South Street, Wandsworth, Surrey, "Improvements in the manufacture of fusees, vesuvians, or other cigar or pipe lights, and in the means or apparatus employed in the manufacture of cigar or pipe lights, lucifer matches, and vestas."

3114. John Anthony Pols, St. Martin's Street, and Peter Owen Bernard, London, "Improvements in obtaining purified or refined oils, and in obtaining oil-cakes from cotton seed and other vegetable substances, also in refining or purifying cod-liver oil."

3116. George Tomlinson Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in the manufacture of india-rubber and gutta-percha compounds."—A communication from Thomas Mayall, Roxburgh, Massachusetts, U.S.—Petitions recorded December 10, 1863.

3152. John Wright, Marple, near Stockport, Cheshire, "Improvements in the manufacture of superphosphate of lime."

3154. Eugene Rascol, Brydges Street, Covent Garden, London, "Improvements in the manufacture of glass."—A communication from Tony Petitjean, Geneva, Switzerland.

3157. Samuel Edwards, Birmingham, "Improvements in grinding pearl, and which said improvements are also applicable for grinding other materials."

3160. William Thornthwaite, Newgate Street, London, "Improvements in the manufacture of chromate of potash, chromate of soda, and other salts of chrome and soda and potash."—Petitions recorded December 14, 1863.

3168. Henry Chadwick, Topsham, Devonshire, and John Clench, Exeter, "Improvements in utilising the waste liquors resulting from the preparation of fibrous matters in paper pulp making, and in the machinery or apparatus to be used therein."

3169. Axel Starck, Leadenhall Street, London, "Improvements in the manufacture of paper from a material not hitherto used for that purpose."—A communication from Matthew Carter, Barcelona.

3297. John Patterson, Beverley, Yorkshire, "Improvements in machinery or apparatus for grinding, crushing, and hulling or shelling various kinds of farm or vegetable produce, applicable also to the crushing and grinding of minerals and other hard substances."—Petition recorded December 30, 1863.

Notices to Proceed.

2141. Walter Weldon, Falcon Court, Fleet Street, London, "Improvements in apparatus for aërial navigation."—Petitions recorded August 29, 1863.

2582. Nathaniel Fortescue Taylor, Manley Street, Stratford, Essex, "Improvements in increasing the illuminating power of coal gas, and in the means or apparatus employed therein."—Petition recorded October 21, 1863.

2677. John Robert Johnson, Red Lion Square, London, "Improvements in the manufacture of lubricating compounds."—Petition recorded October 26, 1863.

MISCELLANEOUS.

CHEMICAL SOCIETY.

The following arrangements have been made for lectures to be delivered at the Chemical Society during the present session:—

March 17.—"On the Organic Peroxides Theoretically Considered," by Sir B. C. Brodie, Bart., F.R.S.

April 21.—"On the Philosophy of British Agriculture," by J. T. Way, Esq.

May 5.—"On the Atomic Weights of the Metals," by Wm. Odling, M.B., F.R.S.

June 2.—"On the Recognition of Bodies by their Optical Properties," by Professor Stokes, M.A., Sec. R.S.

British Pharmacopœia.—We are informed that the smaller and cheaper edition of the Pharmacopœia will not be ready for another month. There must be some good tradesmen on the Medical Council.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following paper will be read:—"On Mordenite." By Dr. How.

Royal Institution.—Monday, February 1, at two o'clock, general monthly meeting. Tuesday, February 2, at three o'clock, Professor Tyndall, F.R.S., "On Experimental Optics." Thursday, February 4, at three o'clock, Professor Tyndall, F.R.S., "On Experimental Optics." Friday, February 5, at eight o'clock, J. A. Froude, Esq., "On the Science of History." Saturday, February 6, at three o'clock, John Lubbock, Esq., F.R.S., "On the Antiquity of Man."

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E C.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 6d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1861, and will be complete in 26 numbers.

Erratum.—Vol. ix., p. 7, *for* "Sorby," read "Daubrée."

J. P. A.—Impossible in the present state of our knowledge.

J. G. P.—The addresses of patentees are given in the printed specifications.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Synthesis of Propylene, by MM. ALEXEYEFF *and* F. BEILSTEIN.*

BROMOFORM dropped upon cooled zinc ethyl produced a lively reaction. The volatile products were entirely absorbed by bromine. This solution treated with caustic soda yielded an oil boiling about 142° C., which had the composition and properties of bromide of propylene. A small quantity of bromide of ethylene was formed at the same time by the disengagement of a little ethylene,—a secondary product in nearly all the reactions of zinc ethyl. Pure bromide of ethyl was left in the cooled tube. The following equation explains the reactions which take place:—

$$\text{Є}HBr_3 + 2Zn\text{Є}_2H_5 = \text{Є}_3H_6 + \text{Є}_2H_5Br + 2ZnBr.$$

The bromide of propylene obtained was treated with ethylate of soda, and the gas disengaged was passed into an ammoniacal solution of protochloride of copper. In this way the yellow allylide of copper was obtained. There can, therefore, be no doubt that the propylene formed synthetically by the union of the two radicals $\text{Є}'''H$ and $\text{Є}''_2H_5$ is identical with the propylene obtained by the ordinary means.

Iodoform appeared to combine with zinc ethyl, and yielded no gaseous products.

The authors could not succeed in forming ethylide of chromium.

On the Purification of Oxalic Acid, by M. MAUMENÉ.

THE process given by some authors for the purification of pure oxalic acid is inaccurate. It is recommended to purify by successive crystallisations, replacing the mother liquors by distilled water. The last crystals, it is said, will be the most pure.

The contrary really happens. However little alkali the acid contains, the successive crystals become richer and richer in it, which is easily understood when the less solubility of the acid oxalates is considered.

M. Maumené dissolved a kilogramme of the ordinary acid in three litres of hot distilled water. The filtered solution deposited an abundance of very white crystals. Sixty-three grammes of these were dissolved in a litre of water, to make a standard solution of the acid. The weather was very cold, and the next day the author found crystals deposited. On calcination, 3·74 grammes of these dried crystals gave a residue of 0·64 $KOCO_2$, corresponding to nearly $\frac{1}{18}$th of their weight of quadroxalate of potash; 4·95 grammes of crystals obtained from the mother liquor of the latter yielded 0·047 $KOCO_2$, equal to $\frac{1}{103}$th of the total weight, or 1 of KO to 88 of C_2O_3.

It is thus evident that the first crystals are richest in alkali, and successive crystallisation from pure water does not affect the purification of the acid.

M. Maumené next examined the yellow mother liquor from the first crystals. This, on spontaneous evaporation, yielded a crop of beautiful crystals. 5·81 grammes of these gave, on calcination, only 0·010 of sulphate of lime, mixed with a little iron, and the residue had no action on reddened litmus. By a crystallisation from distilled water the purification was almost complete. 2·156 of well dried crystals gave only 0·002 of a non-alkaline residue.

The way to obtain pure oxalic acid, then, is to dissolve ordinary acid in sufficient water to give 10 or 20 per cent. of crystals, according to the impurity of the sample. The first crystals are rejected, and the mother liquor is evaporated to furnish a fresh crop, which, after two or three crystallisations, will be found quite free from alkaline oxalates.—*Comptes Rendus*, t. lviii., p. 173.

Easy Preparation of Zinc Ethyl, by MM. ALEXEYEFF *and* F. BEILSTEIN.*

THE authors employ zinc turnings with only a small quantity of zinc and sodium alloy. Zinc turnings alone do not give a satisfactory result; but on adding a few grammes of the powdered alloy to a mixture of them with iodide of ethyl, the reaction immediately begins, and once established, the turnings are attacked by the iodide of ethyl as easily as the alloy, and the process goes on with the same rapidity.

The authors employ the zinc turnings found in commerce, simply dried over sulphuric acid. For 100 grammes of iodide of ethyl they use seven or eight grammes of the alloy and seventy or eighty of zinc. The operation goes on very regularly, and the results are always in accordance with theory.

TECHNICAL CHEMISTRY.

Practical Observations on Soluble Glass. Extract by M. E. KOPP, *from a Memoir by M.* ORDWAY.

(Continued from vol. viii., page 296.)

The threshold of the charging and discharging doors should be on the same plane as the grate, and should very gradually slope to the general level of the sole. Were the doors not thus raised, the melted sulphate and incandescent glass would run out. M. Ordway uses a furnace, the surface of the sole of which measures 40 square feet (422 square decimetres), and the grate 11 square feet (116 square decimetres). The chimney is about 50 feet high, and the opening of the vaulted carneau conducting directly to it is 9 inches high by 20 inches broad. In such a furnace four charges may be made in twenty-four hours, burning about 5000 lbs. of Pictou coal; each charge is composed of 550 lbs. of white sand, from 600 to 700 lbs. of crude sulphate of soda, and from 70 to 90 lbs. of anthracite dust. It is best to determine beforehand the approximate amount of carbon to be employed. The amount of carbon required for two similar charges is not always equal, on account of the variety of accidental influences; for this reason a few pounds should be held in reserve, to be added or not, according to circumstances. When the charge is perfectly liquified, and all the sand has disappeared, if there is an excess of coal, the glass remains black; if there is no excess of coal, the mass takes gradually a pale tint,—as may be seen by now and then taking some out on an iron rod; and when stirred the sulphate separates from the pasty silicate as a clear liquid. One or two pounds of coal should then be thrown into the furnace and well stirred up. Under the influence of the disengagement of sulphurous acid, the mass puffs up, boils suddenly, and then again subsides. It may be necessary to add coal a second or even a third time. The operator requires practice and a certain amount of tact to stop at exactly the right moment. An excess of sulphate may be remedied, but an excess of coal not without difficulty. When the melted mass becomes sufficiently fluid, homogeneous, and clear-coloured, it may be decolorised by arseniate of soda, and withdrawn from the furnace. The fire-irons are changed as soon as they become too hot to offer sufficient resistance.

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* *Comptes Rendus*, t. lviii., p. 172.

* *Comptes Rendus*, t. lviii., p. 171.

To prepare a solution of pasty or liquid silicate, some coarsely ground glass is boiled in water until the solution marks 25° B. = 1·208 p. sp.

If made much stronger, the solution does not easily clarify. Soluble glass is sometimes dissolved by passing the vapour directly into water, but, as the heat is insufficient, the solution is formed very slowly by this process. An iron cauldron, open-heated, is much preferable. The insoluble matters are left to deposit; then, observing, however, certain limits, the decanted and limpid liquid is reduced by evaporation to the different degrees desired. When the liquid thickens, heat should be very carefully applied; for, after a certain degree of concentration, the silicate adheres rapidly and closely to the cauldron; so that, to prevent the adhesion of a spongy matter, the bottom and sides must be incessantly scraped with an iron rod terminating in the form of scissors.

It would be absurd to try to evaporate to dryness. Sesquisilicate of soda can hardly be concentrated to more than 50° B. = 1·525 p. sp.

To obtain the comparatively most concentrated solution of silicate, the purest possible materials must be used for the soluble glass. Earthy or metallic oxides greatly diminish the solubility of the product; and if the slightest trace of them remains, a proportionally larger quantity of alkali is required to enable the mass to dissolve more readily in boiling water. A silicate thus alloyed will not wholly dissolve in water; indeed, when boiled with water, it decomposes into a mere alkaline silicate, which dissolves, and into a voluminous quantity of earthy silicate remaining as residuum,—frequently in the form of wash, flakes, or scales. Thus, a soluble glass, well made in other respects, but manufactured with crude sulphate of soda, yields to water only 89 per cent., leaving a large insoluble sediment, composed of soda, lime, magnesia, alumen, ferrous and ferric oxides, and silicate. Common window glass is really only an alkaline silicate, rendered insoluble by containing a larger proportion of lime or oxide of lead. Fuchs himself insists on the necessity of employing sand free from lime and alumen. He says that a little iron is not hurtful, but this is true only when the glass remains brown or black, the iron being in a state of sulphide. Fuchs further states that insoluble glass cannot be made with pure potash and quartz; "for, if we take two parts of quartz for one of potash, we obtain—as I have ascertained—a glass which partly dissolves in water."

These proportions form a silicate, represented by $3KO,10SiO_3$. "It has long been known, as Scheele has proved, that even ordinary glass, containing lime, is more or less attacked by boiling water. I found that many varieties of glass, when crushed for a long time with water in an agate mortar, give a very sensibly alkaline reaction, and that, by boiling glass, reduced to a fine powder, in water for several hours, a liquid with alkaline reaction is obtained, giving, with sal-ammoniac, a flaky precipitate." M. Pelouze found that, by boiling for some time with water, some finely powdered white glass ($32SiO_3,11CaO,8NaO$), about 3 per cent. was dissolved. Another variety of glass, containing less lime ($13SiO_3,4NaO,2CaO$), abandoned 18·2 per cent. in boiling, and that which formed a solution was sesquisilicate of soda. M. Fresenius affirms that even a glass vessel in water, even for a short space of time, yields a ponderable quantity of its substance. A simple silicate of potash or soda, with three equivalents at most of acid for one of base, may, however, be considered as practically insoluble. M. Péligot finds that the so-called "alabaster glass" is composed almost entirely of silica and potash in proportions suitable to form the silicate ($5SiO_3,KO$), if the whole of the silica enters into combination. But in this glass part of the silica is merely mechanically mixed, thus producing the opacity of the glass. M. Hein has, however, found in "alabaster glass," besides silica and potash, 1·5 per cent. of lime, and 2·3 per cent. of phosphate of lime.

Analysis of Soluble Glass.—By reducing a silicate to small pieces or coarse powder, its degree of transparency shows whether or not it contains any foreign salts. A good product is clear, brilliant, and homogeneous; a badly prepared one appears opaque and resinous if it contains much sulphide or chloride, the mass is spotted, cloudy, or quite opaque. To give soluble glass a milky appearance, it needs even less than 10 per cents of a mixture of saline matters.

The real value of the glass can be determined only by chemical examination; and, as analysis is subject to error, some necessary precautions may here be indicated.

In the case of a solid and dry glass, special care must be taken to effect the solution of all that water is capable of dissolving, a not very easy task, and one requiring both time and trouble. To determine the quantity of alkali, take for analysis an average specimen, and pound a certain quantity very finely in a hard-baked earthen mortar, and pound a certain quantity into very fine powder, but pulverise only one gramme at a time, and take care to avoid all moisture. Then weigh not more than five grammes of the porphyrised substance, and boil them for some time in a porcelain capsule, with from forty to fifty times their weight of water. The boiling should be continued, according to circumstances, during from fifteen minutes to an hour and a-half. To avoid violent sputterings, the mixture which has been heated should be stirred briskly and without intermission. When no uncombined sand is found in the matter treated, the heating may be discontinued, when the stirring-rod no longer encounters particles of sand. Fifteen minutes boiling is amply sufficient for a well-melted sesquisilicate of soda. The presence in a sample of uncombined sand causes uncertainty as to the necessary length of time. If, after an hour's boiling, a sandy residue remains, the operation should be stopped, and the material submitted to a preliminary analysis. If less than 28 per cent. of alkali is present, it is better to recommence the boiling for at least an hour and a-half.

When the solution is complete, add sufficient boiling water to make up a given weight (about forty times the weight of the dry silicate), then cover it and leave it to get cold. After decanting the greater part of the liquid, without disturbing the sediment, weigh a certain quantity of the solution, in proportion to the whole, and test it by the ordinary alkalimetric methods. It is both tiresome and useless to filter; for, though the decanted liquid is seldom perfectly clear, even after long standing, the earthy matter in suspension is too inconsiderable to exercise any sensible influence on the exactitude of the result. If the soluble glass is already in a liquid or pasty state, it should be well mixed with water before being tested, as a concentrated or hot solution is apt to gelatinise before all the acid has been added; it is then impossible to obtain an exact result, as acid afterwards added cannot easily penetrate this thick jelly. Thus, when the liquid operated upon becomes gelatinous, a fresh experiment must be commenced with a weaker and colder solution.

If sulphuric acid has been employed, the liquid which has been tested can be evaporated at the close of the operation; the silica will then be found in the form of a coarse, granular powder, easily washed, collected, incinerated, and weighed. Were the silicate precipitated by an ammoniacal salt, the residuum would probably be very voluminous, and so fine and light as to require the greatest care during calcination, to prevent its being partly blown away.

An excess of nitric or hydrochloric acid added to greatly diluted soluble glass, produces, for a long time, no apparent change; and in a weak solution treated in this way, sulphates or chlorides of iron or arsenic may be searched for without previously separating the silica. In the quantitative determination of sulphates and chlorides, it is better to treat the solution of silicate by an excess of nitrate of ammonia instead of by an acid; the loss of chlorine during the evaporation to dryness is thus avoided.

The presence of sulphides in a liquid soluble glass is determined by throwing into it a small piece of sulphate or carbonate of lead, which, in this case, rapidly blackens.

In determining the proportion of water in a liquid silicate, the solution should never itself be evaporated, for it becomes transformed into a bulky, spongy mass, difficult, or rather impossible to manipulate. This is obviated by previously mixing with the solution a given quantity of freshly calcined lime, of which the weight should be at least double that of the alkali supposed to be contained in the silicate. A few moments after this addition a double decomposition commences, and the glutinous nature of the silicate is destroyed. The whole turns into a friable mass, and, while the water may be evaporated with the greatest ease, all the other substances are retained. A mechanical operation is necessary to determine the proportion of uncombined and pulverulent sand, since all soluble glass holds in combination more or less of these earthy silicates, which remain after the solution in the form of a light sediment. To effect their separation take a certain quantity of coarsely-ground silicate, boil it with water until all that is soluble is dissolved, stir the whole thoroughly, allow it to stand a few moments, then decant, and the decanted liquid will take with it all the silicates held in suspension. After one or two washings in this way, the sandy residuum remaining will represent with sufficient exactness the proportion of uncombined silica.—*Moniteur Scientifique*, vol. xx., p. 63.

On the "Weather-Glass" of Galileo,
by GEORGE F. RODWELL, *F.C.S.*

IN the *Athenæum* for July 26, 1862, the following letter, from a Mr. Thomas Zuiller, appeared :—

"**A Rain-Glass.**—The following may be depended upon as a rain-glass. I have used it for months. Get a common pickle-bottle, such as is sold at every Italian warehouse; fill it with any kind of water, to within two or three inches of the top; plunge the neck of an empty Florence oil-flask into the pickle-bottle. Before rain the water will rise two or three inches in the neck of the inverted flask—often in three or four hours. If the weather is settled for fair, the water will remain not more than half an inch high for days in the neck of the flask. It never fails to foretell rain; and to-day, July 15, rose as high as the rim of the pickle-bottle in the neck of the flask. It may stand in or out of doors, in sun or shade, and the water never needs changing so long as it can be seen through."

A number of letters were afterwards published in the *Athenæum*, the *Field*, and several other papers, relative to this rain-glass, in most of which the writers stated that they invariably found the water rise for fine weather, and fall when rain might be expected—an exactly contrary effect to that observed by Mr. Zuiller.

This "rain-glass" is but a modified and clumsily constructed form of Galileo's air-thermometer, invented more than 260 years ago. It is quite obvious that such a weather-glass can give no reliable results as to the weather from the great extent to which it is affected by the temperature of the air. If the temperature were tolerably constant, a rise of the barometer would cause the water to rise in the neck of the flask; but I do not wonder at Mr. Zuiller finding the water fall for fair weather, after his statement, that the rain-glass may "stand in or out of doors, *in sun or shade*."

An increase of the pressure of the air would, of course, cause the water to ascend, but the ascent would constantly be entirely counterbalanced by the depression due to increase of temperature; so that it might often happen, with a high barometer, and a certain temperature, the water would be lower than with a low barometer and a lower temperature.

In order to gain some idea of the indication which such a barometer as Mr. Zuiller describes would give of the pressure of the air, a Florence flask of the ordinary size, the contents of which were 363 cubic centimetres, and the neck of which had a tolerably uniform diameter of $\frac{5}{8}$ths of an inch, was inverted, and its neck plunged into water, as described in the letter given above. It was placed in the open air, and protected from the sun, and its indications, during a fortnight, compared with those of a mercurial barometer. 1° F. diminution of temperature caused the water to rise in the neck of the flask about ·07 inch, and a rise of 1 inch of the mercury column caused the water to ascend $1\frac{3}{4}$ inch when the effect due to temperature was withdrawn. Thus, a decrease of temperature of 25° F. produced the same effect as the increase of pressure represented by 1 inch rise of the mercury column.

About the beginning of this century, Mr. Alexander Adie invented a very ingenious form of air-thermometer, which could be applied to the measurement of the pressure of the air, and which furnished accurate results. This instrument, known as the sympiesometer (from συμπειζω, to compress; and μετρον, a measure), consists of a glass tube, terminated above by a bulb filled with hydrogen; the lower end of the tube is curved, and communicates freely with the air, and the tube contains oil or glycerine, by the rise or fall of which the pressure of the air is indicated. As near to the bulb as possible, there is a mercurial thermometer, and the temperature must be read off at the time of making each observation; and by means of a movable scale attached to the instrument, we learn the pressure of the air in inches of mercury, which has produced the change in the height of the oil column, when the effect due to increase or diminution of temperature has been withdrawn. By means of this instrument Mr. Adie found the height of Arthur's Seat to be 114·85 fathoms, the actual height being 114·17 fathoms.

The air-thermometer served the purpose both of weather-glass and of thermometer from the time of its invention until the discovery of the barometer by Torricelli, and the invention of the spirit-thermometer by the Florentine Academicians; it was used by Galileo by Bacon, by all the philosophers of the first half of the 17th century. Such being the case, it was thought to be of some interest to determine the indications relative to the weather afforded by an instrument such as was used by these early philosophers, and to examine to what extent it is affected by the pressure of the air.

The instrument as used by the 17th century philosophers is generally described as consisting of a vertical glass tube 2½ or 3 feet long, and "as narrow as a straw," terminated above by a bulb, "about the bigness of a hen's egg;" the lower open end of the tube dipped into a vessel of water, and, by the expulsion of a small quantity of air, water was caused to rise 9 or 10 inches in the stem of the instrument.

The tube used in the following experiments had a diameter of $\frac{1}{16}$th of an inch, and was 2 feet 11 inches long; the bulb was nearly 2 inches diameter, and contained 68 cubic centimetres of air at 48° F. The open end of the tube was placed in a vessel of water, and water caused to ascend in the stem. The water stood 12 inches above that in the vessel below, when the temperature was 44° F., and the height of the barometer 28·975 inches; this was taken as a zero point. The instrument was placed in the open air, near the angle formed by two walls, and the bulb was protected from the sun.

An increase of the pressure of the air, and a simultaneous diminution of temperature, will cause the water to ascend in the stem of such an instrument for the following reasons:—(1) The tension of the outer air will be greater than that of the air within the bulb; (2) the air within the bulb will be contracted by the diminution of temperature; (3) the tension of the aqueous vapour within the bulb will be diminished; (4) the increase of pressure and diminution of temperature will both cause more air to be absorbed by the water within the instrument. Similarly, rise of temperature and simultaneous fall of the barometer will cause depression of the column of water, because the tension of the outer air will be less than that of the air within the bulb; the air within the bulb will be expanded by the increase of temperature; the tension of the aqueous vapour within the bulb will be increased; and less air than before will be absorbed by the water within the instrument.

Increase of temperature and simultaneous increase of pressure will, therefore, give a rise or fall of the water column expressed by the rise caused by increased pressure — the depression due to increase of temperature — the depression due to increased tension of the aqueous vapour ± the elevation or depression caused by the diminished or increased absorption by water of the air within the instrument, which will depend on the relation between the increase of pressure and the increase of temperature, because the former will cause a greater absorption, and the latter a less absorption than before.

1° F. diminution of temperature was found to cause the column of water to ascend ·582 inch, and 1 inch rise of the mercury column caused an ascent of about 8·1 inches, when the correction due to temperature was made; thus 13·91° F. diminution of temperature produced the same effect as 1 inch rise of the barometer.

The effect produced by 1° F. being known, the reduction to the same temperature could obviously be readily effected. As previously stated, the height of the column at 44° F., with the barometer at 28·975 inches, was taken as zero; when the temperature of the air was 50·6° F., and the barometer at 30·23 inches, the column of water was found to be 6·125 inches above zero; required the actual rise of the water column due to increase of the pressure of the air. The increase of temperature above the zero is 50·6-44° F. = 6·6 F.; and as 1° increase depresses the column ·582 inch, the depression due to temperature will be 6·6 × ·582 = 3·841 inches, 6·125 + 3·841 = 9·966, the rise due to increase of pressure alone.

Mr. Glaisher has kindly furnished me with the height of the barometer at the time at which each observation of the air thermometer was made; and the following table shows the height of the water column above the zero point, at the different heights of the barometer, by which it will be seen that about 8·1 inches rise in the stem of an air thermometer, possessing a bulb of such capacity, and a tube of such diameter as that previously described, is caused by a rise of 1 inch of mercury in the barometer:—

I. Height of the Barometer.	II. Actual Ascent of the Water Column in Inches, produced by Increase of Pressure, the effect due to Temperature being withdrawn.	III. Increase of Pressure in Inches of Mercury, producing the Ascent of the Water Column.
28·975	—	—
29·138	1·640	·163
29·328	2·172	·353
29·675	5·453	·700
29·742	6·410	·767
29·750	6·590	·775
29·845	6·849	·870
29·907	7·351	·932
29·974	8·099	·999
29·988	8·367	1·013
30·020	8·203	1·045
30·185	9·746	1·210
30·230	9·966	1·255
30·311	10·595	1·336
30·317	11·170	1·342

These results are of no scientific interest. I was induced to make the experiments detailed above on account of Boyle's statement, mentioned in a previous number,* and my sole object has been to gain some idea of the indications relative to the weather, which were afforded by the air thermometer to the philosophers of the first half of the 17th century.

PHARMACY, TOXICOLOGY, &c.

On Oxycinchonia, an Alkaloid Isomeric with Quinia, by M. Strecker.

The interesting relations which exist between quinia and cinchonia, as much in regard to composition as to origin and properties, have suggested to M. Strecker the idea of seeking to fix on cinchonia the oxygen necessary to make its composition that of quinia. He has succeeded; but the product is not quinia, only an isomer of that base.

The transformation has been effected by the aid of a well-known process, which consists in replacing one eq. H by Cl,Br or I, and afterwards replacing this metalloid by HO, by means of potassa or hydrated oxide of silver.

Monobrominated cinchonia of Laurent is boiled with water and an alcoholic solution of potassa. After a prolonged ebullition, a current of CO_2 is passed into it to neutralise the alkali. After evaporation to dryness, it is washed with water, and the residue treated with boiling alcohol, which deposits, by evaporation, colourless crystalline plates of the composition $C_{40}H_{24}N_2O_4$.

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* See "On the Supposed Nature of Air prior to the Discovery of Oxygen," No. 5, Exp. 18, in the last number of this Journal.

This is the formula for quinia, but it has not the properties of that base. The solutions are not fluorescent, like those of quinia, nor do they yield dalleochin by chlorine and ammonia. Its salts are with difficulty crystallisable; the most crystallisable being the neutral sulphate and oxalate.

The author has named the new base *Oxycinchonia.*—*Jour. de Pharm.*

The British Pharmacopœia.

I.—THE NOVELTIES IN THE PHARMACOPŒIA.

(Continued from page 54.)

BY an inadvertence, the word *tersulphuret* was written last week for *oxysulphuret*. *Antimonium sulphuratum* is the new name for the oxysulphuret of the last Pharmacopœia.

We now proceed with the novelties.

Ferri Arsenias, arseniate of iron, has had a very limited use as a medicine. It is prepared by the double decomposition of arseniate of soda and sulphate of iron. The precipitated arseniate of iron is well washed, and then squeezed in a strong press, and afterwards dried at a temperature not higher than 100° F.

Ferri et Quiniæ Citras, citrate of iron and quinine, is now an officinal preparation. Elaborate directions are given for the preparation of this compound, but, if they are followed, we very much doubt whether anything like the elegant and soluble compound well known in commerce will be obtained. It contains 16 per cent. of quinia.

Ferri Oxidum Magneticum, black magnetic oxide of iron, is a compound from the last Edinburgh Pharmacopœia, but will be remembered by older pharmaceutists as having had considerable use in England years ago. It is a mixed precipitate of the per- and protoxide of iron, which requires no further notice.

Ferri Perchloridi Liquor, solution of perchloride of iron, is used in the preparation of the tinctura ferri perchloridi, which is to replace the former tinctura ferri sesquichloridi. It is made by dissolving two ounces of iron wire in ten fluid ounces of hydrochloric acid diluted with five fluid ounces of water. This solution is peroxidised by the addition of six fluid drachms of nitric acid, and then evaporated to ten fluid ounces. To make the tinctura ferri perchloridi, five fluid ounces of the solution are added to fifteen fluid ounces of rectified spirit. A fluid drachm of the solution will contain 15·62 grains of peroxide, and a fluid drachm of the tincture, therefore, a little less than four grains.

Ferri Pernitratis Liquor, solution of pernitrate of iron. This preparation has been a good deal prescribed for diarrhœa, and now finds its place in the Pharmacopœia. It is made by dissolving an ounce of iron wire in three ounces of nitric acid properly diluted, and afterwards making up the solution to a pint and a-half. A fluid drachm, precipitated by ammonia, should yield 2·6 grains of peroxide.

Ferri Peroxidum Hydratum, hydrated peroxide of iron, is esteemed an antidote in cases of poisoning by arsenic. It must, however, be recently prepared. It is made by precipitating a solution of persulphate of iron with an alkali. As it may be urgently required at any moment, pharmaceutists should keep a solution of the persulphate in readiness.

Ferri Phosphas, phosphate of iron, is a salt which probably every druggist has in his stock, so needs no further notice.

Ferri Sulphas Granulata, granulated sulphate of iron, is not granulated in the now common acceptation of that word. It is here directed to be made by dissolving iron wire in diluted sulphuric acid, and filtering the solution into rectified spirit, whereupon the salt is obtained in minute granular crystals. It could, of course, be made by dissolving the ordinary sulphate of iron in water with a small quantity of sulphuric acid, and filtering that solution into alcohol. Sulphate of iron in this state is not so susceptible to the influences of air and moisture.

Ferri Sulphas Exsiccata, dried sulphate of iron, we dare say, every dispensing chemist has long kept for his own convenience, although the use was not quite justified.

Ferrum Redactum, reduced iron, Quevenne's iron, as it has been called, is iron reduced as far as possible to a metallic state by passing a stream of dry hydrogen gas over the peroxide of iron heated to redness. The article sold under the name is of very variable quality, but, according to the Pharmacopœia, it ought to contain at least half its weight of metallic iron.

Ferrum Tartaratum is the new name for the potassio-tartrate of iron of the London, and ferrum tartarizatum of the Edinburgh and Dublin Colleges. The new name looks like a compromise between the three learned bodies. We would have preferred to retain the old, though somewhat long name, since it expresses the composition of the salt.

Filix, fern root, is now introduced with the ethereal extract well known for a long time in pharmacy.

Glycerinum, glycerine, is naturally added to the Pharmacopœia. It must be with colour and odour, and have the specific gravity 1·26.

Hemidesmus, the root of the *Hemidesmus indicus*, introduced some years ago as a cheap substitute for sarsaparilla, has for some reason or other been added, and a syrup is directed to be prepared. Four ounces of the bruised root are to be infused with a pint of boiling water for four hours, and twenty-eight ounces of sugar are to be dissolved in the strained liquor.

Hydrargyri Nitrates Liquor Acidus, an acid solution of nitrate of mercury now ordered separately for the preparation of the unguentum hydrargyri nitratis; although, when the ointment is referred to, a solution of a totally different sort is seen to be required. The materia medica, and the preparations and compounds of the Pharmacopœia, were evidently sent through the press by different hands.

The acid solution of nitrate of mercury is used as an escharotic by some obstetric physicians, and is sometimes applied to carbuncles. It is to be made by dissolving four ounces of mercury in three fluid ounces and a quarter of nitric acid diluted with three fluid ounces of water. After the mercury is dissolved the solution is to be boiled gently for fifteen minutes.

Kamela.—The present Pharmacopœia is rich in vermifuges, and it will not be for want of a choice of remedies if a single tape-worm is left in a human body. Kamela is no doubt well known to most pharmaceutists as the powder adhering to the capsules of the *Rottleria tinctoria*, and calls for no remark, except that, as stated here, in order to be genuine the greater part should be soluble in ether.

Laurocerasus, a water distilled from cherry laurel leaves, is introduced from the Dublin and Edinburgh Pharmacopœias. A pound of the crushed fresh leaves are to be macerated with two pints and a half of water for twenty-four hours, and then a pint is to be distilled. The water, however, will always be of an uncertain strength.

Lithiæ Carbonas, Lithiæ Citras.—The carbonate and citrate of lithia. These salts call for no observation.

Magnesia and *Magnesia Levis* are the light and heavy calcined magnesia. The former is used in the making of Gregory's powder, now a Pharmacopœia preparation under the name of Pulvis Rhei Compositus.

Magnesiæ Carbonas and *Magnesiæ Carbonas Levis* are the light heavy carbonates, the processes for making which we shall notice at a future time.

Matica matico.—Only an infusion is ordered. Half an ounce of matico, cut small, is infused for half an hour in half a pint of boiling water.

Nectandra.—Bebeeru bark is employed to furnish the sulphate of beberine.

Oleum Coriandri.—Oil of coriander has been placed among the materia medica, for what reason we do not know, since we have not been able to discover any preparation in which it is used.

Oleum Myristicæ.—The volatile oil of nutmeg is now employed in making the spiritus myristicæ, and also in spt. ammoniæ aromaticus.

PHYSICAL SCIENCE.

On the Spectrum of Lightning.

M. Louis Grandeau has published at Mallet Bacheliers an excellent work, entitled "Practical Instruction in Spectrum Analysis," which will be useful to chemists desirous of becoming familiar with the details of this new method of optico-chemical analysis. M. Grandeau gives a description of the principal appearances which have been notified by the researches on the spectrum, and explains how they are to be obtained; two plates upon copper and one chromo-lithograph are given, representing the spectroscope, Geissler's tubes, the spectra of the metals, &c.

We quote a very interesting observation which M. Grandeao himself made, and which relates to the spectrum of nitrogen. In the night of August 13, 1862, this chemist made some researches with a single prism spectroscope upon the lightning which burst at close intervals in the dense clouds in front of his laboratory. He arranged the experiment so that the lightning illuminated the free half of the slit of the collimator, whilst the tube of nitrogen sent its light obliquely into the part of the slit covered by the total reflexion prism. A small quantity of the vapour of water remained in the nitrogen tube at the time it was prepared, sufficient to produce very neatly the characteristic rays of hydrogen superposed on the nitrogen rays. M. Grandean was able during an hour, at intervals of five minutes, to observe the spectrum of the lightning, the general appearance of which recalled at first sight that of the electric spark; but on closer observation, M. Grandean soon noticed in the spectrum of almost every flash the coincidence of a certain number of the rays of this spectrum with those of the spectra of nitrogen and hydrogen. M. Grandean remarks that this result is not to be surprised at, since all admit the production of ammonia and nitric acid under the influence of electrical discharges. Besides the rays of nitrogen and hydrogen, M. Grandeau proves that the lightning spectrum contains the yellow ray of sodium. This observation is, we think, the first application of spectrum analysis to the study of the electric discharge from the clouds.

Apropos of lightning, we remember that M. Andrès Poey intended to study the notes contained in the noise of thunder by means of the tuning forks of Helmholtz, constructed by M. Kœnig, but we do not know if he has followed up his project.—*Moniteur Scientifique.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture IV.—*Saturday, December 19, 1863.*

(Continued from page 57.)

Before proceeding to consider this grand subject of dolomite, which is a great *questio vexata* of geologists, let me direct your attention for a few moments to some of the mineral species occurring in nature. We have, first of all, pure dolomite; that is, a compound of one equivalent of carbonate of magnesia, and one equivalent of carbonate of lime—equivalent to equivalent exactly. It contains exactly 47·83 per cent. of carbonic acid; of lime, 30·43 per cent.; and of magnesia, 21·74 per cent. This may occur not only distinctly crystallised, but granular crystalline, constituting another variety of this mineral, the composition of which, however, is the same. Then we have several other varieties. We have one consisting, for example, of three equivalents of carbonate of lime and two of carbonate of magnesia; then we have another, consisting of two equivalents of carbonate of lime and one of carbonate of magnesia, occurring in Styria and in the Tyrol. There is another, consisting of one equivalent of carbonate of lime and three of carbonate of magnesia; and we have other varieties in which the magnesia is partially replaced by carbonate of iron, constituting brown spar—carbonate of iron and carbonate of magnesia.

The term dolomite, or magnesian limestone, is applied to that substance which consists essentially of carbonate of lime and carbonate of magnesia, and which, when pure, is composed, as I have said, of one equivalent of each. Of this dolomite there are several varieties, and I will give you the following classification, founded upon Senfft's book and also Coquand's. Senfft's is the best, and it is rather surprising to me that so capital a book should not yet have appeared in an English dress. I hardly know any work which would be more useful to geologists than that book, which is written in German. We have there the several varieties, founded upon structure. First of all, we have the granular variety of dolomite. It has a crystalline or saccharoidal, or sugar-like crystalline structure, and it often consists of small, distinct, rhombohedral crystals. Then we have what is properly called the compact variety, which is stone-like in appearance, and may even present a more or less conchoidal fracture. We have another variety, exceedingly porous—if I may apply the expression "porous" to this variety—called the cellular. It is yellowish, or smoke-grey, in colour (rauchgelb,—German), and remarkably fissured in all directions. There is a variety classified as the schistose, or slatey, which occurs in the Jura. Lastly, we have an earthy variety, which is friable and pulverizable. These are all the varieties founded simply upon external characters.

We have other varieties founded upon differences in composition. First, there is the calcareous, that is, the dolomite, which contains more carbonate of lime than is indicated by the formula I have given—dolomite associated with an excess of carbonate of lime. Then there is the siliceous, which contains sand. Lastly, there is the argillaceous, which contains clay in admixture.

With regard to the calcareous dolomite, how do we know that it is dolomite mixed with an excess of carbonate of lime? Why, in this way. If you take that dolomite and reduce it to powder, and act upon it by very weak acetic acid, the carbonate of lime in excess alone will dissolve. Scarcely a trace of the dolomite will be attacked, and there will remain behind, after you have removed all that is capable of being separated by acetic acid, a product having the chemical composition of dolomite. You could not desire, I think, any stronger proof of the fact than this. Dolomite generally, or frequently, is exceedingly free from associated foreign matters, but there are varieties which contain a considerable amount of impurity. One is mentioned in Brazil, in which is found 14 per cent. of quartz mixed with mica; but, as a general rule, it may be considered as a very pure rock, that is, comparatively. Dolomite occurs in nature massive—in great masses apparently—really without any evidence of stratification. It occurs again in regular, distinctly stratified rocks.

Upon these points great questions hang. Dolomite, in some localities—as in the Tyrol—is red and fissured in a most remarkable way, and the possible cause of this we shall have by-and-by to consider. We find, or geologists rather, find in certain localities distinct evidence of the fact, that a limestone bed passes by imperceptible gradations into dolomite. With limestone, there is distinct evidence, I suppose, of stratification in one part; and the other, not distinct, in the same continuous body, shall be converted into unmistakable apparently non-stratified dolomite. That is an important fact to bear in mind. With regard to the mode of formation of dolomite in nature, it is a great problem, one which has excited vast attention, and one which, I am sorry to say, is far from yet being solved in a satisfactory manner. Still, I think we know a great deal more than we did upon the subject, and we know that certain theories which were propounded not many years ago, and which were accepted by geologists as correct, are wholly untenable, so that we get rid of a certain amount of error.

Now, the question is, has dolomite been deposited as such? Is there any case in which we find dolomite, and have reason to believe it has been thrown down, deposited as we find it; or has dolomite resulted from metamorphic action?—that is to say, had it originally a different appearance and different nature altogether, and has it subsequently been generated by what geologists term metamorphic action; or has it been formed by both these methods? I shal proceed to examine these points. I have endeavoured to collect together from various sources all the information upon the subject, and to present it to you in a condensed and available form. I repeat, many interesting problems in connexion with this subject yet remain to be solved. Now, dolomite is found not unfrequently—nay, frequently—associated with gypsum. Hence it was inferred by Haidinger, that dolomite was produced by the action of a solution of sulphate of magnesia on carbonate of lime. Carbonate of lime abounds, we know, in nature, and so does sulphate of magnesia. If we can only bring these things together, we shall have no difficulty whatever in producing dolomite, according to Haidinger, the products being gypsum and dolomite. But we must ask ourselves the question, Suppose we bring a solution of sulphate of lime in contact with carbonate of lime, chalk, will dolomite be formed? At the ordinary temperature, undoubtedly not, but quite the reverse; for when a solution of gypsum percolates through pounded dolomite, this is wholly converted into carbonate of lime, with the formation of sulphate of magnesia,—the very reverse of what was supposed according to theory. Therefore it is perfectly clear that, at the ordinary temperature, Haidinger's theory is wholly untenable. He supposed the case might be different at a high temperature. Accordingly experiments were made upon the subject; and it was shown that a mixture of crystallised sulphate of magnesia and pounded calc spar, in the proportions of one equivalent of the former to two of the latter, when heated in a sealed glass tube, was completely changed into dolomite and sulphate of lime—so completely, that no trace, even of sulphate of magnesia, remained. Here, then, we find that, by the application of heat, an opposite result takes place. But, then, how are we to account for this generation of heat at the bottom of the ocean bed? How is the water to exist at a high temperature? It requires a very high temperature—400° Fahrenheit, 200° centigrade, or thereabouts—in order to effect this change; and if the bottom of the sea be so hot as this, surely there ought also to be a very high temperature above. According to Bischoff, the whole sea ought to have been boiling when this condition obtained. He rather naïvely remarks that, at 17,600 feet, the temperature of the water of the ocean would be 392°, or just that degree at which this change was found to take place in the formation of dolomite, if, as he says, the temperature did not happen to decrease with the depth. Hence, unless Haidinger can show reason for the existence of such a temperature, dolomite, he maintains, could not be formed; and I think that is a very fair way of stating the case. Moreover, if the dolomite of the Tyrol had been thus formed by the reciprocal decomposition of these two salts, he thinks, and I think, properly, that we ought to have found in the vicinity large masses of gypsum, which is not the case. Still, that is an argument which may be open to objection, I admit. Now, bearing upon this point, I will mention to you a curious process which is not publicly known, which I saw in operation about thirty years ago, in Nottingham—a process for making sulphate of magnesia; and it possibly may help on geologists in their consideration of this subject. I saw myself tons of sulphate of magnesia produced in the manner I am about to describe. The process was invented by a Mr. Grisenthwaite; a man who wrote one or two curious books—one a very interesting book, certainly before its day, upon agricultural problems, especially specific manures, in which he pointed out most clearly, and in most unmistakable terms, one of the great points which has been so lucidly and forcibly described by Liebig, long afterwards. He took gypsum and ground it to powder; he took dolomite, calcined that, and ground it to powder likewise. He got then sulphate of lime and caustic magnesia; for, during the calcination, the magnesia was rendered caustic, and the lime was only partially deprived of carbonic acid. He got then, practically, sulphate of lime, caustic magnesia—that is, magnesia deprived of carbonic acid—and carbonate of lime; he put this mixture into large tanks filled with water, and passed through that water a current of carbonic acid, and he produced sulphate of magnesia by the ton. The sulphate of lime dissolves; it is soluble in water. Then you have magnesia and carbonic acid. There is the affinity of the magnesia for the sulphuric acid of the sulphate of lime, and the affinity of the carbonic acid for the lime, which is pretty strong, especially from its producing an insoluble compound, carbonate of lime, and, by virtue of this double affinity, that change was effected, and sulphate of magnesia was formed. Sulphate of lime was decomposed by the joint action of this caustic magnesia, and carbonic acid. I merely mention this fact *en passant*. It may possibly be found interesting. Now, there is the view of Elie de Beaumont, who computed that when one of two equivalents of carbonate of lime is replaced by carbonate of magnesia, owing to the higher specific gravity of the whole and the lower atomic weight of magnesia, there would remain 12 per cent. of hollow space. Well, then, an examination was made, and the result was arrived at from an examination of one specimen—we do not find more—that the amount of interstitial space left was 12·97 per cent. This is a very near approximation, but who would think of founding anything like a theory on a single fact of this kind, which may be a coincidence, for aught we can tell? It is only on repeated experiments, made with infinite care, that we are justified in basing a grand theory on a subject of this kind. A single fact of this kind ought, I think, to be ignored.

We next come to some very important information, or rather experiments, made by Dand, which, to my mind, are exceedingly conclusive so far as they go. His experiments establish the fact, I think unmistakably, that dolomite may be, and is, produced, at all events in certain conditions, by direct aqueous action. In fresh corals he found less than 1 per cent of magnesia, but in compact coralline limestone he found 38 per cent. of carbonate of magnesia. Another rock, consisting of the remains of corals, gave upwards of 5 per cent. There was no indication, he says, of the action of heat. Assuming—and I think it is an assumption which every one would be prepared to make, now-a-days at all events—that the ancient corals were composed like those of modern species, it follows that the magnesia must have been added to these ancient coralline remains, and that could only have arisen from the action of water containing magnesian salts upon the carbonate of lime of the corals, whereby a portion of carbonate of lime is removed and replaced by an equivalent amount of carbonate of magnesia. To my mind, I think that argument is perfectly unanswerable as far as it goes. We find another theory put forth by Sandberger, which explains the formation of the dolomite in Nassau by the action of water charged with carbonic acid upon a black limestone, rich in magnesia. A portion of the lime was supposed to be thus carried away, leaving dolomite, which, as we have seen, is less easily soluble in acid solutions than carbonate of lime itself. The carbonate of lime was again deposited in fissures in the rock as calc sinter or calc spar. Now, let us see whether this is established in any way by experiment. We find some experiments recorded by Bischoff which bear upon it, and which show that carbonic acid dissolved in water acts upon dolomite, containing an excess of carbonate of lime, exactly as the acetic acid does, that is to say, removes the excess of carbonate of lime, leaving dolomite. I will cite the results of two experiments of Bischoff upon carbonate of lime containing carbonate of magnesia. In one the carbonate contained 98·22 per cent. of carbonate of lime and 1·32 per cent. of carbonate of magnesia; and in the other 84·57 per cent. of carbonate of lime and 11·54 of carbonate of magnesia. The carbonate was finely pounded, and mixed with water, and carbonic acid was passed through for twenty-four hours. The solutions were filtered and evaporated to dryness. The first residue contained of carbonate of lime, 2·93, and of carbonate of magnesia, only a trace, showing that none had been removed, or no appreciable amount, by the solvent action of carbonic acid in water, whereas the lime had been removed in large quantities. The second contained 4·29 carbonate of lime and no trace of magnesia; so that I think that point is clearly made out by experiment. Hence it is inferred that by the action of surface-water or sea-water on limestone containing magnesia, the excess carbonate of lime would be removed, and at last only dolomite would remain.

There is another theory put forth by Nauck, that water charged with carbonic acid decomposed the silicates, and deposited the dissolved matters, magnesia and silica, in other places. Silicate of magnesia I refer to especially. This silicate of magnesia thus dissolved by atmospheric water percolates through carbonate of lime, leaves the silica, and combines with a portion of carbonate of lime to form dolomite; carbonic acid here playing evidently an important part. This silica, it was supposed, was deposited in fissures or cavities as quartz or opal.

We next come to another supposition as to the mode of formation of dolomite. Two geological observers, Favre and Marignac, supposed the dolomite of the Tyrol to have been deposited, and not to have been metamorphosed. They supposed that volcanic eruptions occur, attended with the evolution of sulphurous acid, that is, the same acid that is produced when sulphur burns in the open air, and by the action of this acid upon augitic tufa, thrown out and spread over the sea-bottom, sulphite of magnesia was formed; that this sulphite became converted into sulphate (this implies the presence of oxygen necessarily); also that there may have been, as we know may be the case, certain volcanic emanations of hydrochloric acid, by the action of which upon this tufa, chloride of magnesium may have formed. They found that by heating carbonate of lime and chloride of magnesium in a closed glass tube to 200° centigrade during six hours, a precipitate was produced containing 48 per cent. of carbonate of lime, and 52 per cent. of carbonate of magnesia, or substantially, dolomite.

This theory involves the necessity of supposing that oxygen must have been present at great depths to oxidise the sulphite of magnesia, and that a comparatively high temperature existed at the bottom of the ocean. We have already considered this part of the supposition before, and the same remarks which I made with regard to the former theory applies equally to this. We have first to prove the possibility of a high temperature at the bottom of the ocean before we can receive the explanation in question.

Another view concerning the formation of dolomite has created some attention, that of Forchammer. In the first place, he says:—"I designate as dolomite all limestone which contains more than 13 per cent. of carbonate of magnesia." Then, he supposes the action of springs; and he illustrates his supposition by certain geological deposits in Denmark. He supposes the action of springs rising through a coralline limestone. A solution of carbonate of lime is thus produced, and this carbonate of lime, in contact with sea-water, deposits, he thinks, dolomite, or deposits carbonate of lime containing carbonate of magnesia. But this only occurs when the water is boiling hot, so that we have here the same difficulty as I have pointed out on two occasions already. Mr. Sterry Hunt, a very able geologist, and one who has directed great attention, and with great success, to the application of chemistry to geological phenomena in Canada, supposes that water containing bicarbonate of soda, in acting upon sea-water, first decomposes the lime-salts, throwing down carbonate of lime, and only $\frac{2}{100}$ths or $\frac{3}{100}$ths of carbonate of magnesia. Then, when all the soluble lime-salts have been thus decomposed by the further addition of bicarbonate of soda, bicarbonate of magnesia is produced, which, by evaporation, becomes a hydrated carbonate. He admits, but does not prove experimentally, that when you get this hydrated carbonate of magnesia and carbonate of lime in contact under water, they combine slowly to form dolomite. It may be so, but that is one of the points that require special investigation. It seems to me every way reasonable that it should, but still we are not justified in concluding that such a combination does take place without the evidence of experiments.

Let me say one or two words about the grand hypothesis of magnesian vapour. The question which we have to deal with is not the geological structure of these mountains; and in order to illustrate the subject properly, I should require a diagram; but geologists know well the very celebrated locality to which I refer, to which it was attempted to apply this hypothesis of magnesian vapour—that carbonate of lime is deposited, that then, by some subterranean action, there was an eruption of magnesian vapour, which permeated this carbonate of lime, converting it into dolomite. Now, in the first place, magnesia is about one of the most fixed bodies in the world. It should be shown, first of all, that magnesian vapour can be produced. All our experiments lead to the contrary conclusion. But supposing magnesian vapour had been produced—supposing we could have evolved this magnesian vapour, and brought it in contact with the carbonate of lime, how could that have produced carbonate of magnesia? Where is the carbonic acid to come from to form the carbonate of magnesia under those conditions? What do we get? It appears to me the hypothesis, at all events, so far as we know anything of the properties of magnesia experimentally, is absolutely and wholly untenable.

CHEMICAL SOCIETY.

Thursday, January 21, 1863.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

The minutes of the previous meeting were read and confirmed, and the following gentlemen balloted for and duly elected Fellows of the Society, viz.:—Mr. John Pentecost and Mr. Ramsay Morton.

Dr. Thudichum read the first part of a paper "*On Urochrome,*" the colouring matter of the urine. He said that colouring matter was the most obvious of all the ingredients of the urine, and essentially characteristic of the renal secretion. It was the alpha and omega of urinary analogies, as also of urinary pathology. Nevertheless, it had hitherto eluded the scrutiny of physiological chemists; and, although many had obtained certain products, none had actually isolated the colouring matter itself. Indeed, so difficult was the task of doing this, that Vogel, an author who had lately written on urology, had declared it to be impossible. The author believed, however, that if due regard had been paid to the labours of earlier chemists, the question would have been solved long ago. Sixty-three years ago, Proust had had more correct notions and better knowledge of the colouring matter of urine than the authors of the latest publications in Germany and this country. Dr. Thudichum continued by quoting what Proust had said upon the subject. He adverted to the fallow, odorous, and resinous substance which Proust had obtained from the urine by acids. Proust had already hinted that this might be but a product of decomposition of the original colouring matter, as, indeed, it was. This resin was described as fallow, or red, fusing in hot water like pitch, dissolving in alkalies, alcohol, and ether, and as almost insoluble in water. It was the essential principle from which the urine derived its colour and its flavour, and which caused the peculiar smell of linen moistened with urine, when it is heated. Dr. Thudichum next proved the identity of this fallow resin of Proust with a body which Schaeling had obtained from urine, previously concentrated by freezing, by extraction with ether. He showed that ether extracted yellow colouring matter and hippuric acid, and that the latter on heating decomposed the urochrome and yielded Schaeling's body. He next referred to a substance termed "custodine," by Heller, and described as an uncrystallisable brownish-red resin of acid reaction (pigmento-resinous acid), and to another matter termed "indirubine," from urine, by Schunck. He then discussed the nature of the colouring matters obtained from urine by Scherer, Harley, and Marcet, and claimed them to be more or less identical with the fallow resin of Proust, being either fallow resin in a pure state or mixed with peculiar impurities. Another product of the decomposition of urochrome was a peculiar black matter, obtained together with the resin. This had been well described by Proust, but almost entirely overlooked by subsequent writers. Some chemists had persistently thrown it away as dirt. Yet it was a definable chemical body of considerable interest and importance. This matter appeared as a black powder, insoluble in alcohol, and separated thereby from the resin. It was easily soluble in potash, and precipitated therefrom by acids as a bulky, dark-brown clot. On dry distillation, it left 65 per cent. of charcoal, being as much as common coal. Without doubt, persons who had read the account of Heller's "uroxanthine" and Schunck's "indican," would conceive the idea that this black matter might be the indigo derived from the matters just mentioned. But it was as different from indigo blue as the fallow resin was from indigo red. This last-named body was described by Berzelius as being insoluble in dilute acids and alkalies, and thereby differed from the resin, which was soluble in acids, and particularly so in alkalies. Moreover, the author had never found sugar as one of the products of the decomposition of urochrome, and he expressed his belief that the urine contained neither indican, which had the property of splitting up into indigo-blue, indigo-red, and sugar, nor that it contained uroxanthine, having the same properties. He held that the urine contained a peculiar colouring matter, characteristic of the renal secretion, and which he termed "urochrome." This yellow matter could be extracted and obtained in a pure state, as he would show on a subsequent occasion. By exposure to air this matter passed into a red variety, which still remained soluble in water and acids, and corresponded with the urerythrine of former authors, and the rosacic acid of Proust, Vauquelin, and Vogel. This was the matter colouring the pink sediments. Under the influence of acids and heat, when the oxygen of the air was excluded by performing the boiling in a retort in a current of hydrogen, the yellow urochrome became decomposed, yielding the fallow resin, or *uropittine*, and the black matter, or *uromelanine*, several volatile acids and substances, and, perhaps, a soluble matter remaining in the residues. One of the volatile matters the author described as a neutral essential oil, insoluble in water, soluble in spirit and ether, and having the peculiar odour of urine. With nitrate of oxide of mercury it gave the pink reaction on heating, which was observed in a small degree in the analysis made by Liebig's method. It was distinguished from the phenylic acid, also contained in urine, by not yielding a reduction of silver solution on boiling. This essential oil the author proposed to call "the otto of urine." Under the influence of putrefactive agents, the urochrome became similarly decomposed, yielding uropittine, uromelanine, and acetic acid, but little or no essential oil or otto. The author promised to describe more fully the chemical properties of the substances of which he had given a preliminary account, and the mode of their preparation, in a future communication. He added that, in a medical point of view, they appeared of great importance, as the resin sometimes appeared in the teeth of uræmic patients, and the skin of all patients affected with kidney disease excreted uropittine. It was only necessary to smell the exhalation from their skin in order, at once, to appreciate the truth of the assertion, that urochrome and its products of decomposition were most important elements in the theory of uræmia. This theory, as at present accepted, would, therefore, have to undergo modifications by a more extended knowledge of the colouring matter of urine and its bearing in the animal economy.

Mr. Robert Porrett, having made formerly a series of experiments upon the colouring matters of urine, was convinced that there existed more than one principle to which the tinctorial property was due. His experiments were directed to the separation of these bodies by means of sulphate of copper, which always gave a greyish-white precipitate, and this, boiled with potash, became decomposed, and, as the result, allowed the coloured resinous matter to enter into solution. The speaker concluded by expressing his personal obligations to Dr. Thudichum for the very elaborate report he had just now presented to the Society.

Dr. Harley, at the invitation of the President, rose to offer a few remarks upon the subject of Dr. Thudichum's communication. His name having been mentioned beside that of Scherer, with whom he had formerly the honour of being associated, he felt it a duty to record his dissent from some of the views expressed by the lecturer. The multiplication of names for the same substance was to be avoided; and he considered that, before a new term was generally adopted, it became necessary to sift the evidence of former inquirers to see whether or not such body had been previously isolated and described. He contended that the red colouring matter named by Scherer, urohæmatin, was the only principle of its kind existing in normal urine; the proportion in which it occurred was very small, but, by operating upon large supplies of material, a sufficient quantity had been prepared for the purpose of examination. A specimen of this body would be brought for the inspection of the Society, either at its next meeting or the one following; and he hoped by that time to be favoured with an opportunity of comparing it with Dr. Thudichum's urochrome, which he should like much to see. There was no doubt that the body Scherer had prepared contained iron, a circumstance which brought it into close analogy with the colouring matter of the blood. The name very well indicated this similarity, and he thought it feasible to suppose that its existence in the urine was directly attributable to the constant waste of the tissues in the animal organism, and that this was but the natural vehicle for the elimination of the disorganised blood corpuscles. Viewed in this light, the question was one of great importance to physiologists; and the colouring matter of urine afforded, perhaps, the most reliable indication of the state of bodily health, and this might be taken as a direct measure of the rate at which we were consuming the fuel in the lamp of life.

Dr. Thudichum replied to the effect that his experiments had been specially directed to the identification of the iron supposed by some to exist in the colouring matter of urine, but that the amount obtained by him was so excessively minute, that he did not consider himself justified in supposing it to be an essential component. For the detection of iron, the speaker had evaporated large quantities of urine to a small bulk, added nitric acid, and continued the evaporation in a platinum capsule, gradually deflagrating upon the same spot the saline residue thus obtained. On dissolving this matter afterwards in hydrochloric acid, and dividing it into two portions, it was barely possible to identify, by means of the sulphocyanide and ferrocyanide reactions, the existence of iron, its quantity being so small.

A note "*On the Absorption of Mixed Gases in Water*," by William M. Watts, Esq., B.A., was read by the Secretary. The author had made experiments for the purpose of testing critically the truth of Dalton and Henry's hypothesis, which, in effect, asserts that gases in admixture behave as vacua to each other. The subject had already been worked upon by Bunsen, who examined the behaviour of carbonic oxide upon carbonic acid; by Roscoe, who described the results observed in the case of mixtures of hydrogen and chlorine, carbonic acid and chlorine; and the last named author, in conjunction with Sims, had examined ammonia and sulphurous acid. The mode of proceeding could not well be described without the assistance of the drawings, which would be engraved in the Society's Journal, but were on too small a scale to be shown to the meeting. Mr. Watts had, however, examined ammonia and hydrogen, both at zero and 20° C., also sulphurous acid and carbonic acid, in the presence of water, and in all cases had observed irregularities which still remained unaccounted for, whether a diminution of pressure, or diffusion into another gas, were resorted to in the inquiry. The general conclusion of the author's experiments led him to the belief that the proportion of the gases dissolved did not accord with the simple law of Dalton and Henry.

Mr. Adie, of Liverpool, favoured the Society with a further communication upon the subject of "*Ground Ice.*" During the late frosts Mr. Adie had observed opaque masses of ice submerged some ten or twelve feet beneath the surface of a running stream, and in one of these blocks he had counted as many as five stones enclosed. It was considered that the formation of ground ice was instrumental in transporting pebbles from the bed of a river towards its mouth.

The President trusted the ground ice hypothesis might not be open to the imputation, that it was the specific gravity of the pebbles which had caused the block of ice to remain submerged. He then declared the meeting adjourned until Thursday, February 4, when a paper by Dr. How, "*On the Minerals of Nova Scotia*," would be read.

ROYAL DUBLIN SOCIETY.

January 18, 1864.

Sir Robert Kane, M.D., F.R.S., &c., *in the Chair.*

The first paper for the evening was by Mr. Emerson J. Reynolds, on "*Spectrum Analysis*," of which we give the following abstract:—During the last two years the author has been, at intervals, engaged on the examination of Irish ores and minerals for the new metals, thallium, rubidium, and cæsium. Though far from successful in his search for the interesting strangers, although using the extremely delicate spectrum analytical method, yet in examining the large number of minerals necessarily passed in review, some facts were elicited, and observations made, which he would have the honour of laying before the Society. As this was the first paper connected with spectrum analysis which had been presented to the Society, the author expressed his intention of not confining himself to his own experiments, but of giving a general account of the mode of applying this new method of research to the examination of minerals. After briefly noticing the principles on which spectrum analysis is based, the delicacy of its indications, and the important discoveries made by its aid, the systematic treatment of the subject was then entered upon. The forms of apparatus used in making spectrum observations are very varied, but the principle remains the same in all. The essential parts of an instrument of this kind are—the slit, collimating lens, prism, and observing telescope (astronomical). Such is the "spectroscope" in its simplest form; but instruments are now constructed with as many as nine prisms, which have performed the same office for several of the lines of the solar spectrum that Herschel's or Lord Rosse's telescopes have done for some of the nebulæ. For all analytical purposes, the best instrument is that in which only one or two prisms are used, as a larger number obstruct too great an amount of light; and, moreover, the extent of spectrum to be observed is inconveniently large; this is particularly the case when hollow prisms are used, filled with bisulphide of carbon, as the dispersive power of that liquid is so much greater than glass. Spectroscopes, as hitherto constructed, generally have the second or observing telescope movable in an horizontal plane, and, in the case of a double bisulphide of carbon prism instrument, and when at about its mean position, it makes nearly a right angle with the tube carrying the slit and collimating lens. Hoffman, the celebrated optician, some time ago, introduced a very ingenious form of apparatus, which does away with the angular motion of the observing telescope, and enables the experimenter, by direct vision, to examine the spectrum of any flame to which he may point the instrument. Messrs. Yates and Son, of this city (Dublin), have recently introduced an improved form of direct vision spectroscope, which is one of the most perfect instruments of its kind which we have seen. The spectroscope used by the author he has had constructed on a principle different somewhat from that usually adopted. He employs two bisulphide of carbon prisms, with refracting angles of 60°. The peculiarity of the instrument consists in allowing the rays refracted by the first prism to fall on a plane mirror placed at the proper angle, by which they are reflected through the second prism placed with its apex close to the base of the first; by this means, and with a minimum number of prisms, the observing telescope is brought very close to the slit apparatus, so that the experimenter can adjust the latter and keep the source of light, &c., perfectly under command while at the eye-piece of the instrument. The methods by which the spectra of the metals of the alkalies and alkaline earths can be produced are too well known to need any detailed description, but there are some points to which attention may be drawn. The flame of Bunsen's gas-burner is the source of heat generally used, but the author strongly advocates the use of the simple hydrogen flame instead, on account of its more intense action on the bodies submitted to its influence, and the increased brilliancy of the spectra observed. A small apparatus constructed on the principle of a Döbereiner lamp can easily be kept ready for use at a moment's notice. The best jet at which to ignite the hydrogen is the shank of a common tobacco-pipe. The application of the secondary spark of the induction coil for the purpose of obtaining spectra was then noticed, and the advantages to be gained by its use pointed out. The author next alluded to the different modes at present in use for the measurement of the distances between the lines of the spectrum, and exhibited the mode which he adopts for the division of the spectrum. The application of the method of spectrum analysis to the examination of minerals was then treated of. In examining refractory minerals in order to obtain the characteristic spectra of the metals contained in them, the author employs a peculiar form of gas-jet, which is essentially a Herapath's blowpipe jet urged by a current of steam rendered acid by hydrochloric acid. The steam-jet should never be so powerful as to blow the test specimen off the platinum wires. By this means the decomposition of many minerals is effected without having recourse to the previous action of ordinary chemical agents upon them, as has been hitherto necessary in preparing them for examination in the spectrum apparatus. The discussion of the real aid to be derived from the application of the spectrum analytical method to general analysis was then entered upon, and Mr. Reynolds expressed his belief, on experimental grounds, that the various spectra materially interfered with each other, notwithstanding the statements of MM. Bunsen and Kirchoff and others to the contrary; and he showed that the presence of a considerable proportion of sodium and barium compounds, in a mixture of salts of different acids and bases, serves to completely mask or intercept the spectra of lithium, potassium, strontium, and calcium when present in comparatively small quantities. After discussing this portion of the subject at some length, the author expressed his belief that the method of spectrum analysis, as it now stands, beautiful and delicate though its indications are, must be looked upon rather as an useful aid to the ordinary analytical process than as a method of analysis, perfect in itself under all conditions. Mr. Reynolds concluded by observing that be has hitherto been unable to find any traces of rubidium or cæsium in any Irish minerals; but thallium was found in three specimens of copper pyrites from different portions of the Knockmahon mines, Bonmahon Co., Waterford, and in one specimen of the same mineral from Ballydehobb mine, Co. Cork. The amount of the metal present in every case was extremely minute. At the conclusion of the paper Mr. Reynolds gave a short description of thallium, and exhibited several fine specimens of the metal and some of its salts, kindly lent for the occasion by their discoverer, Mr. Crookes. These were handed round and much admired by those present.

The next paper was by Mr. O'Hara, C.E., "*On the Supply of Fuel in Ireland.*" At its conclusion the meeting adjourned.

ACADEMY OF SCIENCES.

January 25, 1864.

A memoir, "*On the Action of Oxygen on Animals,*" was presented by MM. Demarquay and Leconte, which deserves the attention of physiologists and therapeutists. We are glad to see that the possible curative effects of oxygen are once more attracting the attention of physicians and surgeons. A very curious fact observed by the authors was that nearly two litres of this gas might be injected into the veins of an animal without killing it. They found, too, a dog might inhale thirty or forty litres with no other effects than putting him in good spirits and creating a large appetite. They noticed, also, that the respiration of oxygen produced remarkable, and, up to a certain point, beneficial effects on large wounds which they made on animals.

A note, "*On Ammoniacal Fermentation,*" by M. Van Tieghem, was presented. By ammoniacal fermentation is meant the conversion of urea into carbonate of ammonia under the influence of water, a ferment, and a proper temperature. The author is a pupil of M. Pasteur; so we learn that the cause of the transformation of urea is the development of a special organised vegetable ferment. The author also found that, under the influence of apparently the same ferment, hippuric acid splits up into benzoic acid and glycollamine. Beer yeast, it is said, will not provoke the transformation of urea in the presence of sugar.

A note, by M. Reboul, announced the formation of "*Valerylene* $C_{10}H_8$." He obtained it by heating to 140° C. in sealed tubes a mixture of bromated amylene, and a saturated alcoholic solution of potash. Water added to the product of the reaction separated a light stratum, which was a mixture of valerylene, alcohol, and bromated amylene. Cold water removed the alcohol from this mixture, and the very volatile valerylene was separated from the residue by distillation. It is not absorbed by protochloride of copper. It combines with bromine to form a bi-, and, probably, a tetrabromide. Of these and other compounds and derivatives, we shall soon hear more from the author.

NOTICES OF BOOKS.

The Second Step in Chemistry; or, the Student's Guide to the Higher Branches of the Science. By R. Galloway, F.C.S., &c. London: Churchill and Sons. 1864.

This work is intended to teach the higher branches of chemical science, especially the newer views which are now being very generally adopted, and will be found a most efficient manual for the purpose. To criticise the matter of the book is impossible, since it would involve a criticism of all the views on the constitution of bodies which have been put forward by Griffin, Gerhardt, Williamson, Wurtz, Playfair, Frankland, Kolbe, and others. The arrangement of the matter deserves great praise. Mr. Galloway is a practised teacher of chemistry, and he states from experience that the difficult subjects of which the book treats can be taught with perfect success on the plan here developed. We have no doubt of this, and firmly believe that the student who goes conscientiously through the book, performing all the exercises which are given, will find himself, when he gets to the end, an accomplished theoretical chemist.

Practical points, however, are not altogether neglected; and much useful information will be found, particularly on fractional distillations, and the method of determining the boiling points of liquids, &c.

Mr. Galloway has supplied a want which we know has long been felt by the constant inquiries we have had for a work treating of recent theories, and we have great pleasure in recommending the book to our readers.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

3232. James Shanks, St. Helen's, Lancashire, "Improvements in the manufacture of caustic soda and caustic potash."

3264. Joan Maynes, Manchester, "Improvements in the manufacture of certain descriptions of artificial manure, and in apparatus to be employed therein."

3284. Henri Reda de Saint Martin, Old Compton Street, Soho, London, "Improvements in apparatus for aërial locomotion."

3290. Henry Caunter, Stornoway, Lewis, Ross, "Improvements in the manufacture of lubricating matter or composition."

3296. Thomas Barnes Cochrane, Earl of Dundonald, Queen's Gate, Kensington, London, "Improvements in the production of hydro-carbon and other oils from gas tar, coal tar, gas pitch, asphalte, coal and other bituminous substances."

3302. George Phillips, Holborn Hill, London, "Improvements in the production of aniline colours."—Petitions recorded December 30, 1863.

Notices to Proceed.

2293. George Davies, Serle Street, Lincoln's-Inn, London, "Improvements in the manufacture of iron and steel, and apparatus to be employed in such manufacture."—A communication from William Gerhardt, Philadelphia, Pennsylvania, U.S.—Petition recorded September 18, 1863.

2912. George Rait, Canal Bridge, Kingsland Road, London, and John Winsborrow, Castle Terrace, Pownall Road, Dalston, Middlesex, "Improvements in the construction of dry gas meters, and in the means or apparatus employed therein."—Petition recorded November 20, 1863.

2917. Richard Laming, Priory Road, Kilburn, West Hampstead, Middlesex, "Improvements in preparing materials useful in the purifying of gas from sulphuretted hydrogen, carbonic acid, and ammonia, and in making ammoniacal compounds."—Petition recorded November 26, 1863.

2187. William Lorberg, Wyld's Rents, Bermondsey, Surrey, "Improvements in the manufacture of gas and other substances from tan and similar materials."

2189. Samuel Millbourn, Wallington Paper Mill, Carshalton, Surrey, "Improvements in the preparation of materials for the manufacture of paper, and in the construction of machinery employed for such purposes."

2208. Thomas Henry Baker and George Friend, Tunbridge, Kent, "Improvements in treating excrementitious and sewage matters, and in the means or apparatus employed therein."

3116. George Tomlinson Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in the manufacture of india-rubber and gutta-percha compounds."—A communication from Thomas Mayall, Roxburgh, Massachusetts, U.S.—Petition recorded December 10, 1863.

CORRESPONDENCE.

The British Pharmacopœia.

To the Editor of the Chemical News.

Sir,—Can you inform me when I am to begin to dispense the medicines of the new Pharmacopœia; and what I am to do in the case of prescriptions written before the publication of the new formulæ?

I am, &c. M. P. S.

London, February 4.

[Our correspondent may begin as soon as he pleases; and the sooner he gets the new preparations the better for himself, or he will be distanced by competitors in business. With regard to old prescriptions, they ought properly to be dispensed according to the Pharmacopœia in use at the time they were written; but we do not think the differences in the preparations altered are of sufficient importance to make it necessary for a druggist to keep a double stock.—Ed. C. N.]

MISCELLANEOUS.

Inspector of Alkali Works.—The Committee of Privy Council for Trade have appointed Robert Angus Smith, M.D., F.R.S., F.C.S., to be the Inspector of Alkali Works, in conformity with the provisions of the 26 and 27 Vict., c 124. All parties concerned may be congratulated on this appointment, which is, perhaps, the best that could have been made.

Pharmaceutical Society.—Two lectures will be delivered in Bloomsbury Square on the "British Pharmacopœia." 1. On Wednesday evening, February 17, at half-past eight o'clock, by Professor Redwood, Ph D. 2. On Wednesday evening, February 24, at half-past eight o'clock, by Professor Bentley, M.R.C.S. Other lectures will be delivered in the ensuing month.

Royal Institution.—Tuesday, February 9, at three o'clock, Professor Tyndall, F.R.S., "On Experimental Optics." Thursday, February 11, at three o'clock, Professor Tyndall, F.R.S., "On Experimental Optics." Friday, February 12, at eight o'clock, Professor Wanklyn, "On the Synthesis of Organic Bodies." Saturday, February 13, at three o'clock, Professor Frankland, "On the Metallic Elements."

New Reaction for Veratria.—Trapp, of St. Petersburg, has observed that the smallest traces of veratria dissolved in cold concentrated chlorhydric acid, gives a colourless solution, which, on continued boiling, assumes a red colour, that finally becomes very intense, and resembles that of permanganate of potash. This solution remains unaltered by standing for a long time.—*Polytechnisches Notizblatt*, 1863, 96.

Relations of Measures to Weights in the British Pharmacopœia:—

1 gallon	= the measure of	10	pounds of	water.
1 pint	= "	1·25	"	"
1 fluid ounce	= "	1	ounce	"
1 fluid drachm	= "	54·68	grains	"
1 minim	= "	0·91	"	"

Relation of the Weights to Metrical Weights.

1 pound = 453·5925 grammes
1 ounce = 28·3495 "
1 grain = 0·0648 "

Relation of the Measures to Metrical Measures.

1 gallon = 4·543487 litres
1 pint = 0·567936 "
1 fluid ounce = 0·028396 "
1 fluid drachm = 0·003549 "
1 minim = 0·000059 "

—*Appendix to British Pharmacopœia.*

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 2s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

J. Whitfield.—We do not know what compound is meant. Chloride of calcium may be obtained in crystals. Hypochlorite of lime we have never seen in a separate state.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

The Blowpipe Reaction of Copper,

by Dr. B. W. GERLAND.

THE practitioners of the blowpipe will share with me in astonishment when shown that the behaviour of the copper bead in the deoxidising flame—under circumstances whose control can be acquired by practice—is different to that described in chemical literature, and relied upon by all chemists as one of the most characteristic reactions.

After long exercise, I have so far succeeded in the management of the blowpipe flame produced by a gas jet, as to have it sufficiently under my control to use it for all purposes of qualitative and quantitative blowpipe analysis; but I have been unable to obtain the red opaque copper bead on the eye of a platinum wire in the deoxidising flame. The bead thus produced shews the characteristics of glass coloured by protoxide of copper. When removed out of the inner flame, the bead is perfectly colourless and transparent, and remains so after cooling; but when again gently heated by holding it close to the flame, a beautiful ruby red diffuses itself through the glass without disturbing its transparency. This colour is not affected by cooling, but disappears by exposure to a stronger heat, and does not return with cooling. It can, however, be reproduced by a low heat, as in the first instance. The changes are best observed when the bend of the platinum wire is made rather wide, and not too much borax used, so that the bead becomes elongated. If a little copper is dissolved in the flux, the glass is rendered colourless in the deoxidising flame, and one end of the bead is brought near the flame. This half turns ruby-red, whilst the other half is left too cold to take the colour; but the first half, when left for a moment in the exterior flame, becomes colourless by over-heating, and at the same time the other end is heated sufficiently to redden in its turn. When a large quantity of borax is used for the experiment, it sometimes happens that, after treatment in the deoxidising flame, the ruby colour appears during the cooling of the bead.

The reaction is extremely sensitive. If the borax contains so little copper that the oxidised bead scarcely shows a bluish tint, or shews it only when held in the yellow flame, it can in the described manner be coloured a decided ruby. I have even obtained the ruby colour when the only source of the copper was that which the flame volatilised from the copper burner, moistened with hydrochloric acid. The importance of the reaction is still more evident from the fact, that it is not concealed by the presence of other metals which colour the glass under the same circumstances, unless their quantity is so great as to make the bead opaque. If, for instance, the flux contains chromium, the presence of a small quantity of copper manifests itself in the change of the green when treated in the described manner. Such metals as lead, bismuth, &c., which, in the deoxidising flame, darken the glass by the separation of a metallic substance or of a lower oxide, do not interfere with this reaction; for if their quantity is not large enough to make the bead quite black, the ruby colour can easily be observed, particularly by the change produced in warming, whereas in the other case it will be found easy to separate the larger proportion of the metal in flakes, thus leaving the glass lighter coloured. Molybdanium, when present in large proportion, requires attention from the following peculiarity of behaviour. If present in sufficient quantity, this metal colours the deoxidised borax smoky brown, leaving it transparent, but the colour changes into dark brown, and the glass becomes opaque when reheated. It is therefore advisable to volatilise the molybdanium by a longer exposure to the blowpipe flame. I have in this way been able to discover in its compounds minute traces of copper when all other means failed in detecting its presence.

The appearance of the ruby colour in the colourless deoxidised bead seems to be conditioned by the first degree of softening of the glass, and disappears when it is molten. The reaction can be produced both with borax and phosphate of ammonia, but the latter has the disadvantage of making the test less sensitive; and the colouring and discolouring might easily escape notice, in consequence of the low melting-point of the flux. The ruby colour of the salt of phosphorus bead has been already observed by Berzelius, who describes it in the following words:—"Salt of phosphorus dissolves it (copper) with the same colour as borax. The glass, containing a small amount of copper, after treatment in the reduction-flame, becomes sometimes ruby red, and this takes place generally at the moment of congealment." (Berzelius, *Anwendung des Lothrohrs*, 4to Auflage, page 96.) Other authors make no mention of this.

The introduction of metallic tin into the bead, which is recommended to facilitate the deoxidation of the oxide of copper in the flux for the production of red opaque glass, has no effect upon the reaction.

The depth of the ruby colour depends upon the quantity of copper in solution.

In conclusion I have to mention, that in all my experiments by which the ruby glass was obtained, metallic copper had separated from the flux, and was found alloyed with the platinum of the wire. In fact, by prolonged treatment in the deoxidising flame, the copper can be perfectly separated from the glass. The wire can be boiled with water and with sulphuric acid without parting with its copper, but when borax is again fluxed on the same in the exterior flame, this metal slowly dissolves itself. This way of cleaning the platinum is, however, very tedious, and it is preferable to add some saltpetre to the flux.

Macclesfield, January, 1864.

TECHNICAL CHEMISTRY.

Purification of Arseniferous Sulphuric Acid,

by MM. BUSSY *and* BUIGNE.

AMONG the substances which most affect the purity of sulphuric acid, and which it is necessary to separate, arsenic, which is now found in considerable quantities in most acids prepared with pyrite sulphur, is the most important. It is only necessary to call to mind the properties of this energetic toxic agent, and the effect it may have when sulphuric acid is used in medico-legal research, or even in simple pharmaceutical or chemical preparations, to perceive with what care sulphuric acid should be purified before it is used in the laboratory.

In the simple distilling process described in the Codex of 1837, arsenic has not been taken into account; the object of this process was to separate the acid, which is volatile and boils at 326°, from the sulphates of lead and potash which the acid generally contains, and which, at this temperature, become fixed. As to arsenic, which, both in its elementary form and as arsenious acid, possesses a considerable vapour tension, under this condition it is admitted that it will volatilise, in more or less quantity, with the sulphuric acid, and thus that the distilling process is consequently inefficient to separate the arsenic.

It is desirable, no doubt, that only sulphuric acids free from arsenic should be in the market; but as a considerable portion of that produced is arsenical, it must be purified; hence the various processes proposed from time to time.

One of the first is that in which sulphuretted hydrogen is used. This gas is passed into a flask a quarter full of impure sulphuric acid; it is shaken every now and then, left to settle, and filtered through asbestos.

In operating on concentrated sulphuric acid, its partial decomposition is effected by the following reaction, and sulphur and water are produced,—

$$3HS + SO_3HO = 4HO + 4S.$$

It is, then, indispensable to dilute sulphuric acid before submitting it to the action of sulphuretted hydrogen. This gas merely precipitates the arsenic, whilst the acid undergoes, at least to all appearance, no decomposition. The acid must afterwards be concentrated to restore its primitive density; and at a certain point, on account of the high temperature of the liquid, a small quantity of the products of the preceding reaction reappear. Previous dilution of the sulphuric acid only diminishes, without removing, the inconvenience. However prolonged the sulphuretted hydrogen current, sulphuric acid submitted to its action always retains an amount of arsenic perfectly appreciable by Marsh's apparatus.

In a work published in 1845, and an extract from which appeared in the *Comptes Rendus*, vol. xx., p. 794, M. Dupasquier draws the attention of chemists to the advantage of using sulphide of barium as a means of purifying arseniferous sulphuric acids. This chemist finds, in fact, that, both with regard to economy and the purity of the product, sulphide of barium is preferable to hydrosulphuric acid, the inefficiency of which he has elsewhere shown.

M. Dupasquier's process consists in adding 30 per cent. of water to the acid which is to undergo purification, heating to 100°, and then throwing in a few milliemes of crystallised sulphide of barium. Sulphide of arsenic soon collects in the form of a yellowish deposit at the bottom of the vessel; the clear liquid is decanted, and its original density, = 1·85, restored by evaporation.

In presence of sulphuric acid, sulphide of barium becomes sulphuretted hydrogen and sulphate of baryta—

$$BaS + SO_3HO = BaOSO_3 + HS.$$

This instance, then, becomes similar to that preceding, and the sulphuretted hydrogen separates the arsenic as sulphide, by the same reaction as in the other process, only it does it more completely, due to the nascent state of the gas whilst in contact with sulphuric acid.

The same inconveniences, however, attend M. Dupasquier's process, the principal being—1. The necessity of previously diluting the sulphuric acid. 2. The impossibility of immediately expelling the dissolved sulphuretted hydrogen. 3. The necessary reaction occurring during the concentration of the sulphuric acid. And to these is added the special difficulty of the pharmaceutist to obtain pure sulphide of barium. If the sulphide employed is so far impure as to contain one equivalent of hyposulphite of baryta mixed with two equivalents of sulphide of barium, the action of sulphuric acid on such a mixture produces only sulphur and water. The first effect of this action would be to disengage two equivalents of sulphuretted hydrogen and one of sulphurous acid, but these two gases, reacting reciprocally, would decompose according to the equation—

$$2HS + SO_2 = 2HO + 3S.$$

A condition indispensable in M. Dupasquier's process is, then, the use of barium free from hyposulphite, and this condition is not very easy when the salt is prepared at the moment it is required.

This fact, added to those described above, makes M. Dupasquier's process ill-adapted to the laboratory, though it may be very good on a large scale during the course of preparation of sulphuric acid in manufactories. Is there not, for instance, a very serious practical inconvenience in diluting impure acid with 30 per cent. of water, which must afterwards be expelled by evaporation, especially if it be considered that the concentration of sulphuric acid is far from being as simple as that of an ordinary saline solution?

This dilution of the sulphuric acid is not necessary in Buchner's process, which is based on the use of hydrochloric acid. Starting with the principle, that chloride of arsenic boils at 132°, while sulphuric acid boils at 326°, Buchner places the impure acid in a balloon, and gradually raises the temperature, then he passes into it a current of hydrochloric acid, which converts the arsenic into chloride. The hydrochloric acid is then got rid of by a few minutes' boiling in the open air.

This process is both easy and simple; but, unfortunately, it does not entirely free the sulphuric acid from arsenic. We have repeated it several times, under conditions best calculated to ensure success, that is to say, by bringing the sulphuric acid very near its boiling point, and prolonging for more than an hour the current of hydrochloric acid, and yet we have never succeeded in obtaining absolutely pure sulphuric acid. The greater part of the arsenic, it is true, had disappeared, but an appreciable quantity always remained in the product. Hence the means we possess for freeing sulphuric acid from arsenic are satisfactory to neither chemists nor pharmaceutists. Before seeking new processes, we desired to thoroughly examine the effects of distillation on commercial sulphuric acid, and to see whether, as is generally supposed, the arsenic is taken in vapour into the distilled product. M. Dupasquier has already (*Journal de Pharmacie*, vol. ix., p. 419) given the results of experiments which are in opposition to this theory; but being preoccupied with a purifying process applicable to commercial purposes, he has not thought it necessary to insist on these results, and they do not figure in the *resumé* of his conclusions.

I wish, therefore, to draw attention to this point, and to study the distillation of arseniferous sulphuric acid under the most varied and the most positive conditions.

We have a Marsh's apparatus, so precise and sensitive as to enable us to ascertain, in a given weight of sulphuric acid, not only the mere presence, but, up to a certain point, the proportion of arsenic contained in it. With twenty grammes of arseniferous sulphuric acid we have obtained with this apparatus, beyond the heated part, an appreciable quantity of arsenic, in the form of a ring; and we are, moreover, certain that this ring represented the whole of the arsenic yielded in the form of arseniated hydrogen; for in no instance have we succeeded in obtaining the arsenical spot by igniting the gas at the end of the tube. We were thus on the road towards solving the question.

Choosing an evidently arsenical sulphuric acid, obtained from pyrites, we distilled it with the usual precautions,[*] and divided the distilled product into portions. The weight of acid on which we experimented was 840 grammes; its degree of density, 1·82.

The first product distilled weighed 170 grammes; density, 1·54. The second product distilled weighed 280 grammes; density, 1·83. The third weighed 180 grammes; density, 1·84. The residue of this distillation weighed 210 grammes, with a density of 1·84.

Now, by submitting twenty grammes of each of these acids to the test of Marsh's apparatus, we observed two evident and significant facts:—

1st. No arsenic was observed either in the form of ring or spot in any of the three products.

2nd. The residue of the distillation, brought to the original weight by the addition of absolutely pure sulphuric acid, behaved in the same way as the acid first used, and furnished, with the same weight, an exactly similar ring.

Thus no trace of arsenic appeared in the volatile products of the distillation, while the whole of it appeared, and in a concentrated state, in the fixed residue of this same distillation.

Such a result would be difficult of explanation if, as many chemists suppose, the arsenic were present in the sulphuric acid, as arsenious acid. Under an ordinary degree of pressure we know that arsenious acid volatilises below red heat, at a temperature not much above 400°. Its vapour has, then, a sensible tension of its own at 326°, and this tension becomes still greater when arsenious acid exists in a current of vapour like that produced by boiling sulphuric acid. Supposing that the greater part of this acid remains in the residue of the distillation, we ought at least to find considerable quantities in the distilled product, which is not conformable to experience.

On the other hand, if we admit that it is present in the form of arsenic acid, nothing is easier than to explain the precision of the results of the distillation. Arsenic acid is by no means volatile; it decomposes above red heat into arsenious acid and oxygen; but up to that point it gives no appreciable vapour. Under the conditions of the present experiment it may, therefore, be regarded as absolutely fixed, so that, unless by projection or mechanical means, it is easy to understand that the distilled sulphuric acid ought to contain no trace of arsenic.

The following are the direct experiments which confirmed these purely theoretical previsions:— 1000 grammes of absolutely pure sulphuric acid, yielding neither ring nor spot in Marsh's apparatus, we divided into two equal portions; to one portion we added 0·50 gr. of arsenious acid; to the other, 0·50 gr. of arsenic acid. Each portion having been introduced into a similar retort, and placed under the same conditions, we distilled them both, in each case avoiding the least projection, and rendering all the circumstances of the distillation as alike as possible. We thus distilled three-quarters of each portion, leaving as residue, in the retort, a quarter of the acid originally introduced. Having then submitted the two distilled products to the test of Marsh's apparatus, we found, unmistakably, that the portion to which arsenic acid had been added was absolutely free from this toxic agent, while that to which we had added arsenious acid contained very appreciable traces of it. Though many times repeated, the results of this experiment were always the same, so that it is impossible to attribute the presence of arsenic to accidental projection, which might have happened in the case of arsenious acid.

Since it is evident, that as the commercial sulphuric acid on which we operated furnished, by distillation, a product absolutely free from arsenic, the acid must have contained arsenic acid. We have obtained direct proof of this by submitting the residue of the distillation to the two following tests:—

1. We concentrated part of the residue almost to dryness, added a little filtered water, then treated it by nitrate of silver. On pouring ammonia, drop by drop, into the liquid, we saw, immediately the saturation was completed, a red, brick-like precipitate form, characteristic of arseniate of silver.

2. We submitted the other portion to the action of a current of sulphuretted hydrogen, which separated the arsenic in the state of sulphide, its composition corresponding to the degree of oxygenation of the arsenical compound. This precipitate, collected, washed, and dried, was dissolved in ammonia, and then treated by excess of nitrate of silver. All the sulphur of the sulphide of arsenic was precipitated in the state of black sulphide of silver; and the filtered liquid, carefully treated with nitric acid, gave, as in the preceding experiment, exactly at the end of the saturation, the characteristic red, brick-like precipitate of arseniate of silver.

From these experiments, it appears that arsenic acid is not like boric acid, which, though itself fixed, is easily carried off in boiling water vapour. But it must be considered that, although the vapour acts, in some instances, mechanically, it may likewise act chemically, by reason of a special affinity. Thus, boric acid is more easily carried off by alcohol vapour, even at the temperature of 78°, because, as Ebelmen has shown, there exists great affinity between boric acid and alcohol, and the combination resulting from this affinity possesses the property of volatilising in a current of alcohol vapour. No such affinity seems to exist between sulphuric and arsenic acids. Experiments have proved that the latter preserves all its fixity, even when placed in a current of boiling sulphuric acid.

The above results, moreover, accord perfectly with the conclusions in M. Dupasquier's memoir (*Comptes Rendus*, vol. xx., p. 794), namely, that arsenic in commercial sulphuric acids is in the state of arsenic acid. Nevertheless, the many experiments we have made on other sulphuric acids drawn from different sources do not allow us to adopt this conclusion unreservedly.

The state in which the arsenic is present must evidently depend on the mode of preparing the sulphuric acid. The two elements essential to the formation of sulphuric acid, nitric and sulphurous acids, exert, with respect to the compounds of arsenic, a very different action, the first changing the arsenious into arsenic acid, the second, on the contrary, converting the arsenic into arsenious acid. Thus, according to the agent remaining in excess at the close of the operation, we have an oxidising or a reducing effect—a fact we have proved by experiment.

Among the numerous acids on which we have operated, some there are—not very many, it is true—in which arsenic existed evidently in the state of arsenious acid, AsO_3. Concentrated and submitted to the two tests above described, these acids failed to give the red, brick-like arseniate of silver precipitate, but gave instead a light yellow precipitate characteristic of arsenite of silver. Distilling them with the preceding precautions, we found that the product was not absolutely free from arsenic, but contained slight traces of it, which agrees perfectly with the foregoing theoretical and practical indications.

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[*] The principal rules are: 1st, to use the grille annulaire, now generally employed, which allows the liquid to be heated from the top; 2nd, to put into the retort fragments of quartzite or pyromac silex in flakes, which are of great use in preventing bumping and, consequently, avoiding accidental projections of liquid.—(Lembert, *Journ. de Pharm.*, vol. xii., p. 166.)

We at first imagined that the presence of arsenious acid in such acids was incompatible with the coexistence of nitrous products, and experiment verified our surmise. Our own experiments have shown us that the sensibility of narcotine and sulphate of protoxide of iron, as a means of appreciating the presence of nitrous compounds, exceeds the limit of $\frac{1}{100000}$.[†]

Now, by neither of these re-agents have we obtained an appreciable reaction in sulphuric acids which contained arsenic in the state of arsenious acid.

This relation between the state of the arsenic and the presence or absence of nitrous compounds, is very valuable, affording a means of rendering the distillation efficacious in either case.

Suppose it were desired to purify a decidedly arsenical sulphuric acid; begin by testing it either by narcotine or sulphate of protoxide of iron. If it contains nitrous products, we may be certain that arsenic is present as arsenic acid, AsO_5. It is then necessary only to add a few millièmes of sulphate of ammonia,[‡] and then to distil, carefully avoiding any kind of projection. The product is shown by Marsh's apparatus to be wholly free from arsenic.

Does the testing by re-agents shew, on the contrary, the absence of nitrous compounds? There is every reason to believe that arsenic is present in the form of arsenious acid, AsO_3; and experiment proves that simple distillation without any previous treatment is insufficient.[§] In such a case the sulphuric acid must be boiled with a little nitric acid, which fixes the arsenical compound by transforming it into arsenical acid, AsO_5. Then add sufficient sulphate of ammonia to destroy the excess of nitrous compounds, and finally distil under the same conditions as the preceding. The product is free from arsenic, and quite as pure as that of the preceding operation.—*Journal de Pharmacie et de Chimie*, vol. xliv., 177, 63.

Bleaching Sponges, by M. Artus.

On a first trial M. Artus washed some good sponges several times in river water, and placed them, still wet, in a bath composed of six parts of water and one of commercial hydrochloric acid, there left them until carbonic acid ceased to be disengaged, when, after very careful washing, they were strung together and suspended in a vessel containing diluted hydrochloric acid and 6 per cent. of hyposulphite of soda dissolved in water. This vessel was well closed, and left for forty-eight hours, and the sponges afterwards taken out and washed in fresh water. M. Artus afterwards made a similar experiment, but doubled the quantity of hyposulphite of soda. Subsequently, in a third operation, the sponges, on being removed from the bath, were treated by diluted hydrochloric acid, from which they were freed by repeated washings in water, and were immediately exposed to the action of sulphurous acid. By each of these three methods nearly the same result is obtained, but the sponges were not perfectly blanched. A fourth method was then attempted. The sponges were well washed for some time in hot, diluted soda lye; then, as in the last experiment, they were immersed in a bath of weak hydrochloric acid and hyposulphite of soda, but only half the quantity of this salt employed in the first experiment was used. A satisfactory result was thus obtained.—*Moniteur Scientifique.*

PHARMACY, TOXICOLOGY, &c.

The British Pharmacopœia.

I.—The Novelties in the Pharmacopœia.

(*Continued from page 66.*)

We conclude in this number our account of the novelties in the Pharmacopœia.

Podophylli Resina.—This is podophyllin, the resin obtained from the root of *Podophyllum peltatum*. Podophyllin was introduced from America, and our supply of the medicine has hitherto been obtained from the States. Directions for the preparation of it are, however, given in the Pharmacopœia as follows:—The root is to be exhausted by rectified spirit, and the greater part of the spirit is to be distilled from the tincture. The residue is then to be slowly poured into water acidulated with hydrochloric acid. The resin is thrown down by the water, and is collected on a filter washed and dried. The object of the hydrochloric acid is not very clear. Podophyllin is a powerful cathartic. The test given is, "almost entirely soluble in ether," which might be said of half a dozen substances with which podophyllin could be adulterated.

Potassæ Permanganas.—Crystallised permanganate of potash is ordered for the preparation of a liquor potassæ permanganatis, in the proportion of four grains to an ounce of distilled water. The crystals of the salt should always be used, and not the fused lumps often sold, which contain a variable proportion of caustic alkali. A process is given for the preparation of the permanganate, about which it need only be said that care must be taken to carry the heat far enough, and continue it long enough, or the first crop of crystals will be sulphate of potash.

Potassii Bromidum, bromide of potassium, is placed in the British Pharmacopœia. The process for making it given is, by dissolving bromine in solution of potash to a very slight excess, evaporating the solution to dryness, and fusing the pulverised residue with charcoal. The fused mass is dissolved in water, the solution filtered, and the bromide obtained in crystals in the usual way. This process is most generally followed by makers of the salt.

Saccharum Lactis, sugar of milk, has been borrowed from the homœopaths, and placed in the Materia Medica; but we have not yet discovered any compound in which it is prescribed, nor can we think of any in which it should be. Under some circumstances it is a very useful food for infants. We would quote the description of the characters of sugar of milk, but it is too long. It is impossible, however, to resist the description of

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[†] We have prepared sulphuric acid perfectly free from nitrous products by boiling it with a little sulphate of ammonia, and we have proved that sulphate of protoxide of iron, reduced to powder and thrown into this liquid, there preserves its whiteness unsullied. But on taking 50 grammes of this acid, and carefully mixing it with a single drop of nitrous nitric acid—that is to say, about 1-1000th in weight—the re-agent immediately acquired a remarkably intense violet colour. By adding successively to this mixture increasing quantities of pure sulphuric acid, so as progressively to reduce the proportion of nitrous nitric acid, we obtained a dead rose colour when the proportion of this compound was reduced to 1-100000th. Narcotine is almost as sensitive; but, as it becomes yellow under the influence of pure sulphuric acid, it is more difficult to determine where the foreign coloration ceases. We believe, however, that it is less sensitive than sulphate of protoxide of iron.

[‡] The addition of sulphate of ammonia decomposes the nitrous products, as proved by M. Pelouze.

[§] The quantity of arsenic distilled in the case of arsenious acid is really very small, yet sufficient to render the acid containing it unfit for medico-legal researches.

Saccharum Album, refined sugar. "Compact, crystalline, conical loaves, snow-white, dry, scentless, and intensely and purely sweet." This description does the author great credit, whoever he may be; it is almost as good as Dr. Johnson's description of net-work.

Santonica.—This drug is known as *Semen contra*, or worm seed, though it is not a seed, but "the unexpanded flower-heads" of a species of artemisia. The flower-heads themselves are used as an anthelmintic; but a crystalline neutral principle is to be obtained from them, which is supposed to possess all the power of the drug. *Santoninum*, the principle in question, is procured from santonica by a very simple process, although the directions here given are very long.

Scammoniæ Radix.—Scammony root is now placed in the Materia Medica for the preparation of scammony resin, an article which the medical profession and pharmaceutists have long had the opportunity of using, but have declined to do so. As the use of it is still optional, except in the misturæ scammonii (a most absurd preparation to put in this Pharmacopœia), there will yet be very little demand for it. It is obvious that the object of using the resin in the mixture is to have a medicine without smell which will deceive a child; scammony, therefore, cannot be substituted, or rather will not fulfil the object. Scammony resin is obtained from the root by exhausting it with alcohol, adding a little water to the tincture, and then distilling off the spirit. The residue is removed while hot, and when it has cooled, any supernatant liquor is poured away, and the resin is then dried. The misturæ scammonii mentioned above, is made by triturating four grains of the resin with two fluid ounces of milk.

Soda Caustica, caustic soda, needs no notice.

Sodæ Arsenias, arseniate of soda, is here described as crystallising with fourteen atoms of water, although, in general, it obstinately crystallises with twenty-four atoms. This, however, is not of any consequence, since the salt is always to be used dried at or below 300°. The liquor sodæ arseniatis is made with four grains of the dried salt to a fluid ounce of distilled water.

Spiritus Pyroxylicus Rectificatus, rectified wood spirit. What this is placed in the Pharmacopœia for we cannot imagine.

Terebinthina Canadensis.—Canada balsam is put in to replace Chio turpentine, which is here omitted. It will be ordered in pills, we presume, which the dispenser will have to make with a considerable bulk of magnesia.

Zinci Carbonatis, pure carbonate of zinc, we presume is added to replace calamine, which is dismissed from the Pharmacopœia.

Zinci Valerianas, valerianate of zinc, is made, by the process of the Dublin College, from valerianate of soda. Very few of our readers will think of making this salt, so we need not quote the instructions.

We have now gone through the Materia Medica, and made our readers acquainted with all the more important additions and alterations. In future notices, we shall go through the list of preparations and compounds, commencing, however, with the galenical preparations.

At this stage it may be expected that we should express some general opinion on the merits of the British Pharmacopœia. In forming this opinion, it is impossible to forget that the book has now been more than four years in preparation, and that it has cost a sum of money variously stated at 6000*l*. or 8000*l*. We have, of course, no interest in depreciating the value of literary and laboratory work, but we have no hesitation in asserting that, for aught we have been able to discover to the contrary, the work could have been as well prepared in less than twelve months by any moderately-accomplished chemist and pharmaceutist, who would have thought himself richly rewarded with 400*l*. or 500*l*.

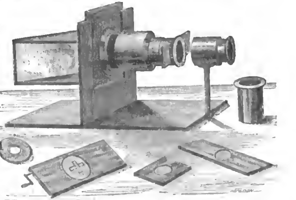
No doubt the contentions between the three colleges about their rival preparations were frequent and severe; no doubt, the debates on such questions, as whether iodine should be called iodum or iodinium, and whether pil. galbani co. should, for the future, be known as pil. assafœtidæ co. or not, were as long and fierce as the disputes in the old schools on such questions as—How many angels can balance themselves on the point of a needle? We, however, have only to judge of the results. Although the book has been all these years in preparation, it bears evident marks of having been put together in a hurry. Some of the directions are incomplete and faulty. The bulk of the work is mere compilation. Much of it is taken up with prescriptions such as medical men should be left to write at their discretion: *e.g.*, mist. creosoti, mist. scammonii, pil. plumbi c. opio. The chemistry does not fairly represent the science of the day. Taken altogether, the book would be no great credit to a single college or writer. As the production of the collective wisdom of the Medical Council, it is far from likely to increase the respect which that learned body has inspired.

PHYSICAL SCIENCE.

New Lantern Polariscope.

MR. SAMUEL HIGHLEY, the microscope and philosophical instrument maker of Green-street, Leicester-square, has just introduced an arrangement that has long been a desideratum with those who delight in popularising science—namely, a polariscope that could be used in conjunction with the numberless magic lanterns that are now scattered over the kingdom and our colonies, without entailing the risk and trouble of sending them to the optician "to be fitted" with such an adjunct, and at a cost that is within the means of most persons who indulge in such pursuits.

Mr. Highley's instrument is figured in the annexed woodcut. The various parts are mounted on what the inventor calls a "gout-board support." The upright is



fitted with an adjustable panel, that carries a bundle of glass plates on one side, and the stage and power on the other. This allows of the entire arrangement being accurately "centred" with any lantern with which it may be employed. When adjusted, the panel is clamped by means of a milled-head screw. The "bundle" consists of such a number of thin glass plates as will give a bright reflected beam of polarised light, and is attached to the panel at the proper angle for producing such a beam. The spring stage for carrying selenite designs, unannealed glasses, pressure and heating clamps, and the larger objects, is formed within a large tube attached to the front side of the panel; and to the front of this is screwed a spring jacket, within which slides the power and stage for the smaller crystals employed. To the front part of the base-board an adjustable rod is fixed that carries the analyser, which consists of a large prism, made expressly for the purpose of giving a large and pure field of colour, the absolute field attainable being, of course, dependent on the intensity of the source of light employed, as oil, oxy-calcium, oxy-hydrogen, or the electric. Provision is made for rotating both the smaller and larger objects, when necessary for the demonstration of certain phenomena. When selenite designs are shown on the screen, the crystal power is replaced with another of suitable construction. To use this polariscope, the nozzle is placed at right angles to the screen, and the base-board is then clamped to the table. The front lenses of the magic lantern are removed, the condensers only being employed, and the source of light moved till a beam of parallel rays is produced. The lantern nozzle is then pointed at the bundle till the rays are incident at the polarising angle for glass, the proper direction being indicated for the uninitiated by a white line marked on the framework, the right adjustment of parts being further indicated by the appearance of an even disc of light upon the screen. A design is then inserted in the large stage, its lines of construction focussed, the analysing prism inserted in its jacket, and the coloured effect produced and varied either by the rotation of the prism or the rotation of the design or crystal.

By removing the panel from the support, and placing it before a window with nozzle pointing upwards, and adding a suitable power, it may be then used as a table polariscope, or the light of a reading-lamp may be employed as the source of light.

By this simplification of parts, Mr. Highley is enabled to supply an instrument—which for practical purposes can hardly be surpassed for efficiency—at one-half the price at which the gas polariscopes hitherto constructed have been sold. We fancy that many will appreciate this attempt to bring a costly instrument within the reach of experimentalists.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 4, 1864.

Professor T. Redwood, *Ph.D., in the Chair.*

The minutes of the preceding meeting were read and confirmed. Mr. James Duncan and Mr. T. J Glass were admitted Fellows of the Society; and Mr. J. Wrightson, M. Antonio Alves di Ferrara, and Mr. Charles Lambert, were balloted for and duly elected Fellows of the Society.

Dr. Odling read a paper, by Dr. How, "*On Mordenite, a Mineral from the Trap of Nova Scotia.*" The author referred to the previous labours of Messrs. Jackson, Alger and Gesner, who had described a great number of the interesting minerals of Nova Scotia. The subject of the present communication, Mordenite, had been so named from its occurrence in the vicinity of East Morden, in the Bay of Fundy. It did not offer much attraction to mineral collectors, for it rarely presented a crystalline appearance, but was usually found in the form of hard nodules or concretions, of an indistinctly fibrous structure, embedded in the trap rock, where it resisted well the disintegrating action of the weather. It was sometimes found underlying sulphate of baryta, and occasionally was associated with apophyllite. Mordenite belongs to the class of fibrous zeolites fusing without intumescence, and giving gelatinous silica, with hydrochloric acid. The author had analysed several specimens of the mineral, and the numbers so obtained pointed to a chemical constitution very similar to Haüylendite.

The Chairman, after moving a vote of thanks to Dr. How for his communication, announced that a series of special lectures would be delivered in the course of the present session (for programme, *vide* Chemical News, vol. ix., p. 60); but he was sorry to remark that, beyond a qualified promise on the part of Professor Kolbe to address the Society in April or May next, the Council had not been successful in inducing any eminent foreign chemist to accept their invitation.

The business of the meeting, which lasted in all only twenty minutes, was brought to a conclusion by adjournment until the 18th inst.

PHARMACEUTICAL MEETING.

Wednesday, February 3, 1864.

Mr. Sandford, *President, in the Chair.*

On commencing the business of the evening, the Chairman alluded to the recent publication of the British Pharmacopœia, and expressed a hope that the members of this Society would do their best to facilitate the introduction of the changes which had been made in the various preparations. A question had been put as to when it would be proper to begin dispensing the new preparations, and it had been suggested that Physicians should write "B. P." on prescriptions they wished to be dispensed according to the new formulæ; or "Ph. L.," if they intended the medicines to be compounded according to the old. Both of these plans he thought open to objection, since there must come a time when it would be necessary to entirely leave off dispensing the old preparations; for the present it was certainly necessary that both the old and new preparations should be kept by pharmaceutists.

Mr. C. Tomlinson then read a paper "*On the Verification of Castor Oil and Balsam of Copaiba by their Cohesion Figures.*" The author began with a general account of castor oil. This oil is obtained from the seeds of the *Ricinus communis*, which are either boiled in water and then pressed, or are pressed cold, to furnish the hot or cold drawn oils known in commerce. Much of this oil, of a good quality, and very cheap, is imported from Bombay, and the author believed he had been able to examine perfectly pure specimens from that presidency. A good quantity of the oil was also received from New York, and some from Australia. The seeds had also been imported from the East Indies, and the oil pressed out in this country. The plant was cultivated all over the East Indies to yield oil for burning; it was grown around their houses by the natives, who crushed the seeds, boiled them with water, and skimmed off the oil to burn in lamps. The largest quantity of the oil was imported from the East Indies, but in late years Italy had become a formidable rival. The machinery for obtaining the oil had been brought to great perfection in that country, and 45 tons of oil were obtained from 120 tons of seed. Castor-seed cake was in considerable demand as a manure for hemp-fields; and the oil, which is easily saponified, is made into soap, as well as used for burning. The plant was also cultivated in France, where it had been found that a plant from one seed would yield 900 seeds, which furnished half their weight of oil. But castor oil obtained from plants grown in temperate regions was found to be weaker than that procured from plants grown in the tropics. Some of the physical properties of castor oil were well known. It was a viscid, yellowish fluid, having a somewhat acrid taste, which varied somewhat according as the oil was freshly prepared or old. It remained fluid almost to 0° F., and was soluble in alcohol. The latter fact was considered a test for the genuineness of the oil; but Pereira found that castor oil had the property of promoting the solubility of oils in alcohol which alone were insoluble in that medium. Thirty per cent. of lard, nut, and other oils, in combination with castor oil, were found to be soluble in alcohol; and a mixture of one part olive oil, and two parts castor oil, gave, with two parts alcohol (sp. gr. ·860), a perfectly homogeneous solution. A concentrated castor oil was made by a small addition of croton oil, which could not be detected by chemical means, any more than the 30 or 50 per cent. of other oils which might be mixed with castor oil. Chemistry failing to detect these admixtures, recourse might be had to a physical test. This test depended upon the forces of cohesion, adhesion, and diffusion. A drop of the liquid to be tested was carefully dropped upon chemically clean water in a clean vessel. The force of adhesion endeavoured to spread the oil in a thin film over the surface of the water; the force of cohesion in the oil strove to prevent this; and from the contest of these two forces there resulted figures which the author believed to differ in the case of every independent liquid. There might be instances of two or more liquids differing in chemical composition, but having the same physical properties, and in these cases the figures produced on the surface of the water would be identical; such cases, however, must be rare. Since the cohesion figure depends on surface adhesion, it is necessary that the water should be chemically clean. Distilled water need not be used, New River water having been found to answer well. The vessel employed must be scrupulously clean. Simple washing and wiping with a cloth are not sufficient. The glass must be washed with strong sulphuric acid, then rinsed with water, again washed with caustic potash, and finally well rinsed with more water. The interior of the vessel should not be wiped. With regard to the shape of the vessel, the author had found a conical glass, having a diameter of four inches at the top, to answer well. The oil must be dropped on the water from a glass rod which has been cleaned in the same manner as the vessel described above. When the oil is dropped, the rod should be held about one-tenth of an inch from the surface of the water, so as to avoid splashing, and also in the cases of oils somewhat heavier than water—oil of cloves, for example—to avoid the influence of gravitation, which would immediately carry the drop to the bottom of the vessel. In general, only one drop should be allowed to fall, as the effects are not always the same; but in the case of a very volatile liquid, like ether, the figure of which lasts but a second, several drops may be dropped in succession from a tube as the figures disappear. So, also, in the case of creosote; but after the fourth drop this body ceases to give a figure, in consequence of the water becoming saturated. [Mr. Tomlinson described the cohesion figures of ether and creosote, and exhibited some beautiful drawings, without which the descriptions would not be intelligible to our readers. We can, therefore, only recommend our readers to make the experiment for themselves, and carefully observe the results.] The figures of the fixed oils are more durable, some lasting for several hours. This is the case with castor oil, the figure of which is of great beauty. As soon as this oil is dropped it spreads out in a series of rings, magnificently iridescent. Outside these is a silvery corona, which soon breaks up into a delicate lace-like pattern. This appearance lasts some hours, but eventually only a colourless disc of the oil is left. The same phenomena were remarked in all the castor oils examined. An important point to be observed in making these experiments is the temperature. The author has found the best temperature to be 60° F. How far the test could be applied to detect adulterations was yet hardly determined, since there was great difficulty in procuring undoubtedly pure specimens of oils from which to obtain standard figures. Mr. Tomlinson saw the oil expressed from linseed at the International Exhibition, and thought he had got a perfectly pure oil; but it turned out that other seeds were largely mixed with the linseed. There were other difficulties in the way. Oils differed somewhat according to the climate in which they were obtained, and the density of oil of lavender was known to differ in different years. Mixtures, however, could undoubtedly be detected. In these, the figures produced partake of the characters of both the constituent oils. A mixture of olive oil and sesame oil gives a figure which is at once that of neither, but both oils, yet most resembling that of the oil which is in excess. A mixture of lard oil with castor oil is best shown in what may be called the residual phenomena, the lace-like pattern being scattered over with numerous small blotches. Croton oil gives a magnificent figure of large pattern, and a mixture of 5 per cent. of this oil with castor oil may be readily detected by the practised eye. Turpentine gives a remarkable figure. The film flashes out immediately almost to the edge of the vessel, and the outer circumference is seen dotted with numerous small bosses, which are larger within, and enclose patches of iridescent colours. The pattern afterwards opens into holes, forming a network of great delicacy. For balsam of copaiba a good test was very desirable. The figure produced by the balsam was a magnificent sight. A succession of rings were thrown out, showing beautiful colours and a metallic lustre. A mixture of castor oil and balsam was instantly detected by the figure produced; neither colours nor border pattern was seen. In concluding, Mr. Tomlinson said he did not look on the investigation as complete. The subject was one that courted further examination, but he believed it would be found that every independent liquid produced a definite figure, which would serve for its verification, as the form of a crystal led to the identification of a salt.

In the course of the discussion which followed, Professor Miller said that, knowing the practical difficulties in the way of applying the test successfully, he could only recommend intending experimenters to pay particular attention to Mr. Tomlinson's remarks on the necessity for cleanliness. Every trace of grease must be removed from the glass and rod, or the results would be altogether vitiated.

Dr. Attfield inquired, whether the bed of liquid could not be varied, so that a single test might show mixtures of particular oils?

Mr. Tomlinson, in reply, said, his physical test was not a chemical analysis. He had tried several different beds, and always found different figures produced; but he had come to the conclusion, that water was the best surface and capable of the most general application. He might mention that the test had been submitted to some severe practical trials. A friend engaged in the oil trade had brought various specimens for examination, and was so convinced of the value of the test, that he remarked, "The oils write their names on water." In reply to a member, he added, that cod-liver oil gave a figure; but another experiment showed him that the specimen he had tried, when mixed with one-third fish oil, gave exactly the same figure. He also tried oil of spike, and obtained the same figure as with turpentine. On referring to a book, he found that oil of spike was made with four parts turpentine and one part oil of lavender.

Mr. Sanger then read a paper "*On the Process of Percolation as Applied to the Preparation of Tinctures*," a report of which we postpone until next week.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 12, 1864.

J. C. Dyer, Esq., *Vice-President, in the Chair.*

The President, in the name of a number of members, presented to the Society a portrait of one of its Vice-Presidents, J. P. Joule, LL.D., F.R.S., by G. Patten, A.R.A., of London, and intended to be hung up on the walls of the meeting-room.

On the motion of Professor Christie, seconded by Mr. Atkinson, it was resolved, "That the best thanks of the Society be given to Mr. Binney and the other donors of Dr. Joule's valuable portrait."

Mr. John Rogerson was elected an ordinary member of the Society.

On the motion of Mr. Dyer, seconded by Mr. Sidebotham, it was resolved, "That the Society do hereby authorise the Council to procure a die for a medal, and to settle the design."

The following extract from a letter from T. T. Wilkinson, F.R.A.S., was read:—"On referring to the article 'Dodo,' in the *English Cyclopædia*, I find that Mr. Sidebotham is mistaken in supposing that his photographs exhibit 'the *earliest* figure of this now extinct bird.' The frontispiece of De Bry's '*Quinta Pars Indiæ Orientalis*,' A.D. 1601, contains 'a pair of these birds on the cornice on each side' of the ornamental border. Clusius, in his '*Exotica*,' A.D. 1605, also gives a figure, which he says is copied from the journal of a Dutch voyager, who had seen the bird in a voyage to the Moluccas in A.D. 1598. Mr. Buxton's '*Histoire*' appears to follow next in order; since the Journal of Admiral Pater Wilhelm Verhuffen, as quoted by the late Mr. Strickland, was printed at Frankfort, in A.D. 1613."

A paper was read by Henry E. Roscoe, B.A., Ph.D., F.R.S., entitled "*Note on the Amount of Carbonic Acid contained in the Air of Manchester.*" Determinations of the quantity of carbonic acid contained in the air of towns have been made by Dr. Angus Smith in Manchester, and by Lewry in Paris; but as the experiments hitherto made upon the subject are few in number, and have yielded somewhat remarkable results, it appeared of interest to carry out a series of determinations of atmospheric carbonic acid, made by unimpeachable methods, and extending for a considerable time, under wide variation of weather. The analytical method employed was the excellent volumetric one proposed by Pettenkofer, and this was checked in several instances by simultaneous weight determinations made by absorption in caustic potash. The close agreement of the results gives proof of the reliability of the methods. The experiments were made under my supervision by Mr. Arthur McDougall. In the case of the weight analyses, a given volume (not less than 35 litres) of air was drawn in the first place over three weighed tubes containing sulphuric acid and pumice-stone, the weight of the third tube being shown to remain constant; the air then passed through a Liebig's bulb containing potash; over two tubes containing solid potash; and, lastly, through two tubes containing sulphuric acid and pumice-stone, the weight of the second of these remaining constant. The volumetric analyses were made in globes of 7-10 litres' capacity, with standard solutions of baryta-water and oxalic acid, exactly according to the method described by Pettenkofer. The first and most important conclusion to which these experiments lead is that the amount of carbonic acid contained in Manchester town air differs but very slightly (if at all) from that contained in the air of the neighbouring country. Thus, from experiments made at Stretford (four miles west of Manchester) with the wind blowing towards Manchester, the quantity of carbonic acid found on Feb. 3, 1863, was 3·85 volumes in 10,000 volumes of air, as a mean of two experiments; whereas, on the same day, the quantity found in the centre of Manchester (Owen's College) was found to be 3·90 volumes in 10,000 volumes of air, as a mean of two experiments. Three experiments made at Stretford on Feb. 19, 1863, a damp day, with wind blowing from Manchester, showed a mean of 2·77 volumes of carbonic acid; whilst at Manchester, on the same day, the volume of carbonic acid was found to be 2·8 in 10,000 volumes of air. The maximum quantity of carbonic acid was found in Manchester air on January 7, 1864 (on which day there was a dense fog), when the amount reached 5·6 volumes per 10,000 of air; the minimum quantity on February 19, 1863, being 2·8 volumes per 10,000 of air. The mean of 46 determinations made in the centre of the town of Manchester, gives the volume of carbonic acid as 3·92 in 10,000, and that of eight experiments made outside the town gives the number 4·02 as the composition of the country air regarding carbonic acid. These numbers closely agree with a determination by weight which I made in London on February 27, 1857, from which the carbonic acid in London air was found to be 3·7 volumes per 10,000. Other experiments prove that continuous rain may lower the amount of atmospheric carbonic acid from 4·8 to 3·3 volumes per 10,000. The above results show that the maximum quantity of carbonic acid contained in Manchester air, even in a dense fog, and when there is no wind, does not exceed 6 volumes per 10,000 of air; whilst the mean quantity, 3·9 volumes, closely agrees with that (4·0) generally assumed, from Saussure's early experiments, to represent the average composition of the atmosphere as regards carbonic acid. Hence we may conclude that the combustion of coal and the respiration of animals exert no appreciable influence on the quantity of carbonic acid contained in the town air of Manchester collected in an open situation; gaseous diffusion and the great motions of the atmosphere serving completely to disperse the millions of tons of this gas which every year are evolved by the above-mentioned causes in this neighbourhood. I may add the following determinations, made in the same way, of the carbonic acid contained in the air of closed inhabited spaces:—

1. Chemical Theatre, Owen's College, during lecture.
   Temp. 9° C. Bar. 755 mm. CO_2 in 10,000 of air 9·5 vols.
2. Chemical Laboratory, Owen's College.
   9 o'clock a.m. Temp. 17·5°. Bar. 733·5. $CO_2 = 8·3$ vols. in 10,000.
   12 o'clock. Temp. 19·5°. Bar. 733·5. $CO_2 = 9·0$ vols. in 10,000.
3. Large bedroom, with invalid and attendant.
   Temp. 12°. CO_2 in 10,000 vols. of air = 7·4.
4. Parlour (capacity 3000 cubic feet), four persons, three gaslights, good fire.
   Temp. 19°. CO_2 in 10,000 vols. of air = 13·2.
5. Ditto ditto.
   Temp. 18°. CO_2 in 10,000 vols. of air = 13·6.
6. Ditto ditto.
   Temp. 15°. CO_2 in 10,000 vols of air = 14·5.
7. Crowded meeting-room of artisans in Penny's Mill, Gaythorn—Guardian Schools—1000 persons.
   Temp. 18°. CO_2 in 10,000 vols. of air = 36·5.
   CO_2 in 10,000 vols. of air = 35·5.

MICROSCOPICAL SECTION.

December 21, 1863.

Joseph Sidebotham, *Esq., President of the Section, in the Chair.*

Various valuable donations were announced, among others a paper by Walter Crum, Esq., F.R.S., "*On Cotton*

Fibre," accompanied with mounted specimens in illustration of it.

Mr. Hays repeated his observations on the cotton fibre, and said that there was little difference observable in cotton freshly gathered, from that as usually received in this country. His observations lead him to the conclusion that the structure of cotton fibre is as follows:—First, there is an external envelope, or tube, generally moniliform; inside, a spiral vessel which seems to prevent the collapse of the tube; inside the spiral there is generally present another substance like a pith or core. Mr. Heys then described at length his observations on the cotton when under the influence of the solvent recommended by Mr. O'Neil, and the conclusions he drew from them. Mr. Heys' paper was illustrated by diagrams and mounted specimens.

Mr. Heys then read a paper "*On Mounting Objects in Canada Balsam,*" and minutely explained the various details of the process: he strongly advocates the use of the Canada balsam, dissolved in chloroform, by which the trouble is lessened, and the beauty of the preparations increased.

The Secretary then exhibited a drawing of the apparatus used by Captain Baker, of the *Niphon*, for obtaining soundings free from grease.—Description: A tube 18 inches long, 1¼ diameter, with a wooden cap, and a leather, fitted as a pump-box; this, lashed to the lead, sinks into the earth, and brings up a cylinder of mud or sand, free from grease; the surplus water being forced out through the valve at the top.

ACADEMY OF SCIENCES.

February 6, 1864.

An important communication on "*Isomorphism*" was made by M. Maumené, who, after very careful experiments, has decided that no pyro- or meta-arseniates can be formed. We shall give an abstract of the paper next week.

M. Pagliari presented a note "*On a New Process for Preserving Animal Matters,*" in which he states, that a liquor composed of alum, gum benzoin, and water, will preserve animal matters for an indefinite time in the open air. The solution when dry forms a sort of skin, which protects the meat from the contact of air and "ferments."

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(ELEVENTH NOTICE.)

(Continued from page 58.)

In noticing the "Colouring Derivatives of Organic Matters, Recent and Fossilised," the author commences with the most important of the "recent," viz., madder and its derivatives. Madder, it is observed, has probably given rise to more researches and experiments than any other colouring matter, and yet our knowledge of it is extremely confused and uncertain. Whether there is more than one colouring matter in madder, or whether, indeed, there is anything more than a "colour-generating substance," are questions as yet undetermined. That there are differences in the chemical properties of madders of different countries, is well known, but "the conditions of these differences have not been traced with precision." The most recent researches lead to the supposition that fresh madder contains a bitter, colourless principle (*rubian*), probably a *glucoside*, which, by various methods, is transformed into alizarin, purpurin, and probably other products. This view is supported by a number of phenomena observed in practice, and, moreover, best explains Kopp's process for the economic preparation of alizarin and purpurin. Kopp's process is the following:—Ground madder is macerated with ten or twelve times its weight of water, containing 2 or 3 per cent. of sulphurous acid. The solution thus obtained is filtered, and the residue pressed. The solution contains the colouring matter. When mixed with 3 per cent. of sulphuric acid (sp. gr. 1·52), and heated to 30° or 40° C., purpurin is deposited. The mother liquor of the purpurin is now heated to boiling, when it gives off CO_2, and deposits alizarin, coloured greenish-black by foreign substances. This is collected and washed. The acid mother liquor is used for converting the exhausted madder residue into weak garancin. The above is certainly a simple and economic method of obtaining madder extracts, and deserves the attention of English manufacturers.

The properties of alizarin and purpurin are well known. The main distinctions between the two are, that purpurin is more soluble than alizarin in water, alcohol, and solutions of aluminium salts, and that it dissolves in alkalies, forming a liquid of a fine currant-red colour, from which the alkaline earths throw down red lakes. Alizarin, on the other hand, dissolves in alkalies with a violet colour, and forms violet blue lakes with the alkaline earths.

According to Strecker the formulæ of alizarin and purpurin are—

Alizarin . . . $C_{10}H_6O_3$
Purpurin . . . $C_9H_6O_3$

To these Dr. Stenhouse has lately added a third from East Indian madder, munjeet, and which he names munjistin—$C_8H_6O_3$.

We need not go further into the preparation of madder extracts by sulphuric acid or other means, which must be well known to our readers.

The colouring principles of lichens are rather shortly disposed of in the report, but an excellent account is given of French purple, which we extract at length:—

"French Purple.—This beautiful colour has been introduced and is chiefly manufactured by MM. Guinon, Marnas, and Bonnet, of Lyons (France, 167). It is prepared as follows:—The lecanoric, erythric, evernic acids, &c., of the lichens are extracted by digestion with ammonia; the mass is pressed, the solution precipitated by a mineral acid, and the precipitate collected, washed, and redissolved in ammonia by the aid of heat, whereby a solution is obtained, which, on exposure to the air at a temperature of 19° or 20° C., gradually assumes a very bright red colour. As soon as the tint has acquired sufficient intensity, the liquid is introduced into shallow basins, and very slowly evaporated at a temperature between 40° and 60° C., care being taken not to exceed the latter limit. By this evaporation in contact with the air, the liquid after a few days acquires a very deep violet colour, which undergoes no further change even by the action of acids. The violet solution, super-saturated with a strong acid, yields a copious flocculent precipitate of a very fine and rich garnet colour, which, when collected on a filter, and washed to remove the saline mother liquor, constitutes French purple.

"The dye thus prepared has not, however, attained the highest degree of beauty and purity of which it is susceptible. When used directly for dyeing wool or silk (for which purpose it does not require the aid of mordants, the colouring matter being simply dissolved in ammonia, and the solution diluted with the proper quantity of water), it imparts to them a violet colour having a reddish cast.

"To obtain the dye in a state of greater purity, it is converted into a lime or alumina lake. For this purpose, the ammoniacal solution is precipitated with chloride of calcium or with alum; the red colouring matter then remains almost wholly in solution, and the lakes are collected, carefully washed with cold water, and dried at a gentle heat. They then present a violet or bluish aspect, and acquire a coppery lustre by friction.

"French purple is generally sent into the market in the form of lime-lake. To render it available for dyeing, the lake is decomposed, and the colouring matter set free. For this purpose the lake is reduced to an impalpable powder, which is boiled with oxalic acid to separate the lime, and the colouring matter then dissolved out by ammonia. The lake may also be directly decomposed by boiling it with carbonate of ammonium. For printing, the lake is dissolved in acetic acid, and the solution mixed with alcohol, and thickened.

"In this manner, very fine and pure mauve and dahlia tints are obtained, especially on silk, without the use of mordants, properly so called. French purple, moreover, mixes easily with other colouring matters, such as ultramarine, indigo-carmin, cochineal, aniline-red, &c., producing the most varied and delicate tints.

"Recently, however, the manufacture of French purple has been greatly diminished in importance by the formidable competition of the coal-tar purple. The upshot of this struggle will depend on the relative beauty and purity of the tints obtained, and on their comparative cost; for, so far as regards fastness and resistance to the influence of light, French purple is certainly not inferior to aniline-purple."

A Handbook of Practical Telegraphy. By R. S. Culley, Telegraphic Engineer and Superintendent. London: Longman and Co. 1863.

Some of our readers will no doubt have noticed an advertisement in the *Times* a few weeks ago, inviting a number of young gentlemen to compete for appointments to work the Indian telegraphs. Now, supposing—though we are bound to say the supposition is a most absurd one—that the questions put to the candidates by the civil service examiners related to the business in which they would be afterwards concerned, Mr. Culley's is the very book to which intending candidates should give an attentive study in order to prepare themselves for the examination. It contains information on the construction and effective working of a line of telegraph, as well as a clear exposition of the science concerned; and Mr. Culley's long experience as a superintendent and engineer is a guarantee that the information is complete, and may be relied on.

NOTICES OF PATENTS.

2669. *Improvements in Deodorising Refuse Organic, Fæcal, and Urinous Matters; and in a Method of Utilising Coal and other Ashes; and in Machinery or Apparatus connected therewith, for producing a Portable Manure therefrom.* J. Harrop, Manchester, and J. Wadsworth, Salford. Dated October 3, 1862. (Not proceeded with.)

The inventors employ for disinfecting the matters named in the heading, common salt, either alone or in admixture with soot, ashes, or dried earth. From the materials so treated an excellent manure is manufactured by adding a small proportion of hydrochloric acid (to guard against the evolution and consequent loss of ready-formed ammonia), and evaporating to dryness either in open pans, or, more economically, in exhaust apparatus. With the product so obtained, the inventors prefer also to incorporate a quantity of common ashes and cinders of coal, such mixture constituting a manure of great efficacy, and one in which the relative proportions of animal and vegetable ingredients may be subject to modification according to the purpose for which it is required.

2712. *Preparation or Manufacture of Manure.* J. Beale, Maidstone, and M. A. Beale, Barnsbury. Dated October 7, 1862.

This invention is very similar to that just now described: the fæcal matters are mixed with soot, lime, common salt, and dregs of assafœtida. This last ingredient will, without doubt, have the effect of disguising the nature and origin of the matters entering into the composition of the manure, but it may happen that the odour is not thereby improved.

2718. *Treatment of Violet Colours derived from Coal-tar Oils.* P. Clavel, Paris. Dated October 8, 1862. (Not proceeded with.)

With the object of rendering the violet colours derived from coal-tar soluble in water, the inventor treats them with cold, fuming, Nordhausen sulphuric acid, employed in such quantity as to affect complete solution. The mixture is then gradually poured into water, and a current of steam passed through the diluted solution, and from this liquid the violet colouring matter is precipitated, either by adding common salt or by an alkali. Again, a current of steam is passed, and the ebullition thus maintained for about half an hour, by the end of which time the violet substance will have become flocculent, and may be easily collected on a filter and well washed. It is then in a fit state to be dissolved in boiling water to produce a solution which is at once appliable to the purposes of dyeing and printing.

It is probable that the several kinds of violet dye, although prepared from a common source, would exhibit differences in their degree of solubility when treated with sulphuric acid.

2726. *Manufacture of Paints or Pigments.* J. H. Johnson, Lincoln's-inn Fields, London. A communication. Dated October 9, 1862.

The patentee's first claim relates to the manufacture of pigments from finely-divided metallic copper, employing either that which has been fused and afterwards run into water, or otherwise divided, or the inventor takes electrotype deposits of a brittle kind and reduces them to powder. The second claim refers to the use of benzole as a solvent for gummy, resinous, or bituminous matters in the manufacture of paints and varnishes, and as a ready means of combining gums, resins, &c., with metallic or mineral pigments. The application of these substances to all kinds of surfaces hitherto coated with paint is mentioned under a third heading.

2756. *Improvements in the Manufacture of Silicate of Soda, or Silicate of Potash, and in the Manufacture of Artificial Stone.* C. Thomas, Bristol. Dated October 13, 1862.

For the purpose of aiding the solution of silica in the boiling potash or soda, the inventor has resort to a machanical process, whereby the gelatinous coating first formed upon the exterior surfaces of the hard silicious particles is rubbed off by constant attrition, fresh surfaces becoming thus presented to the solvent action of the alkali. The apparatus used by the patentee consists of a close iron boiler mounted upon a horizontal axis, so that it can be rotated or oscillated, and it is preferred to apply heat by means of a steam-jacket fitted around the boiler.

The artificial stone is manufactured by treating with the silicate of soda certain waste products obtained in the process of making alkali, particularly the "black ash waste" and the "burnt pyrites." Either of these materials being ground to powder, and used singly or in admixture, is made into a stiff paste with a strong solution of the alkaline silicate, and whilst moist is shaped or moulded into blocks or bricks for building purposes. On drying, these substances form a hard stony material, which afterwards resists the action of water.

2837. *Cement.* J. Duke and J. Clever, Puriton, Somersetshire. Dated October 21, 1862.

This cement is prepared by calcining together lime and silicate of alumina in such proportions as to give a product not widely different in character from Portland cement. The inventors first calcine blue-lias limestone, mountain limestone, chalk, or other kind of carbonate of lime, in the ordinary kilns, until burnt to lime; this is then slaked and intimately mixed with finely-ground kaolin, slate-clay, potter's clay, fire-clay, or other material composed entirely or chiefly of silicate of alumina, such admixture being facilitated by stirring them up together with water, running off the top liquid, and allowing the particles afterwards to settle by standing at rest. When they have thus subsided, the water is run off, and the white deposit collected, dried, and burnt until a double silicate of alumina and lime is formed; the product is then ground to a fine powder, and in this state constitutes an excellent cement.

Grants of Provisional Protection for Six Months.

209. Charles Bolton, Moreton Street, Pimlico, London, "Improvements in apparatus for producing optical illusions, which may be used for dramatic and other entertainments."—Petitions recorded December 19, 1863.

259. Nathaniel Lloyd and Edwin Hargraves, Church, near Accrington, "Improvements in treating printed and dyed fabrics."—Petition recorded December 24, 1863.

23. Auguste Lucien le Harivel, Tweedmouth, Northumberlandshire, "Improvements in the manufacture of paper, papier mâché, cardboard, and other similar articles."

30. Joseph Judge Hays, Hitchin, Hertford, "Improvements in the manufacture of peat, charcoal, and in the apparatus employed therein."

63. William Clement Beatson, Rotherham, Yorkshire, "Improvements in furnaces employed in the manufacture of certain descriptions of glass, and also improvements in the manufacture of plate glass."—Petitions recorded January 9, 1864.

Notices to Proceed.

2203. Ludwig Mond, Appleton, Widness, Lancashire, "Improvements in obtaining sulphur and sulphurous acid from 'alkali' waste."

2252. John Adams Whipple, Boston, Massachusetts, U.S., "Improvements in apparatus for supporting photograph cameras."—Petitions recorded September 12, 1863.

2255. Thomas Bell, Wishaw, Lanarkshire, N.B., "Improvements in apparatus for distilling shale or other bituminous minerals."

2256. George Whitfield Billings, New York, U.S., "An improved method of preparing the fibres of hemp, flax, and other vegetable materials for manufacturing purposes."—Petitions recorded September 14, 1863.

CORRESPONDENCE.

Oleum Coriondri.

To the Editor of the Chemical News.

Sir,—In the Ph. B., page 339, in the formula for Syr. Sennæ, you will find 3 minims of Ol. Coriandri ordered in 2 lb. 10oz. by weight, which is 1 minim in 14 oz.; the maximum dose of the P.L., 1851, was ℥ss.; and if this quantity is still given, the quantity of the oil, you will perceive, is a mere trifle. I am, &c.

Alex. Gow.

Wolverhampton, February 6.

The Red and White Rocks of Hunstanton.

To the Editor of the Chemical News.

Sir,—My attention has lately been drawn to the above red rocks. In the course of my examination, I intensely magnified a portion, and noticed it to contain small, shelly-like globules of different colours,—white, black, and some resembling in colour tortoise-shell, predominating.

To show the very minute size of these, I may say, that when a sample is pounded to its finest in an agate mortar and magnified, these globules still remain, and show themselves unbroken. In the Chemical News for the last week of the year 1861, I see Mr. Clapham has given the analysis of both the red and white chalk. Perhaps he, or some other gentleman, can enlighten me as to the nature of the above observation. I am, &c. C. W.

P.S.—I may as well also state that the sulphuric acid in my sample, is in larger quantity than the amount Mr. Clapham gives in his analysis.

MISCELLANEOUS.

BRITISH PHARMACEUTICAL CONFERENCE.

The annual meeting of the members of the British Pharmaceutical Conference, which, it will be remembered, is an organisation chiefly for the encouragement of scientific inquiry into matters connected with pharmacy, will this year be held at Bath at the time of the visit of the British Association to that city. Of the subjects suggested for investigation, the following have been accepted, either by the gentlemen who proposed them, or by other members; and a paper on each question (or an abstract of the paper if the author shall have previously published his results) may be expected to be read at the meeting:—

Extract of *Fucus vesiculosus* is occasionally prescribed for use in medicine. When made by the action of proof-spirit, a green product is obtained; when by water, a red extract results. What is the most eligible form in which to exhibit any medicinal principles that may be present in the plant? Accepted by J. Whitfield.

Valerianate of Zinc. Describe an easy method of determining the purity of this salt as found in commerce. Accepted by F. Sutton.

Valerianate of Iron. What is the best process for the preparation of this salt? What are its characters, and how may its purity be most readily ascertained? Accepted by F. Sutton.

Syrup of Senna. Devise a formula for this preparation which shall afford a syrup less prone to ferment than that of the London Pharmacopœia. Accepted by J. A. Knights.

Methylated Spirit. Required, an easy method of detecting methylic alcohol in the presence of ethylic alcohol. Accepted by J. Tuck.

To what extent is dialysis applicable in determining the nature of the crystalline constituents of plants? Accepted by J. Attfield.

Report on the applications of Glycerine in Pharmacy. Accepted by F. B. Benger.

What is the quality of the diluted solution of Phosphoric Acid met with in commerce, and what the best and safest method of obtaining it of constant strength? Accepted by R. Parkinson.

Ergot. What is its active principle, and what the best preparation for its administration? Accepted by R. V. Tuson.

Cusparine, in the *Cusparia febrifuga*. Mr. Haselden undertakes to make a communication on this subject.

Euphorbine, in the Euphorbia. Professor Tuson will add to some experiments he has already made on this substance, and report the result to the Conference.

Hyoscyamine. Mr. Tilden engages to add to our knowledge of this alkaloid.

Pereirine, in the bark of *Geissospermum Velosii*, Allem. Dr. C. A. Martins will communicate a paper on this body.

Some of the pill masses of the Pharmacopœia are of inconvenient consistence, or acquire that condition by keeping; can this be obviated? Accepted by E. Wood.

Concentrated Infusions. Required, processes which will yield stable products that give on dilution infusions resembling those of the Pharmacopœia, and which can be conducted with facility on the small scale. Accepted by T. Grundy.

Podophyllin. What is the nature of the commercial article, and what process will yield a definite substance? Accepted by J. Spearing.

Report on processes for the separation and estimation of alkaloids in medicinal extracts, &c. Accepted by T. B. Groves.

Report on the modes of preventing the rancidity of medicinal fats. Accepted by T. B. Groves.

Report on the weights and measures used in pharmacy. Accepted by B. S. Proctor.

On microscopic analysis applied to pharmacy. Accepted by H. Deane and H. B. Brady.

To what does Senna owe its active properties, and what is the best solvent of the same? What is the comparative medicinal value of senna leaflets and senna-pods? Accepted by J. A. Knights.

What is the quantity of Tannin in English Galls (*Cynips quercus-petioli*) at different stages of their growth? Can they at either of these periods be employed economically as a substitute for the nut-galls of commerce? Accepted by W. Judd.

Steel Wine. What is the best method of obtaining this preparation of uniform strength and appearance, and what the quality of commercial specimens? Accepted by F. Sutton.

Potentilla Tormentilla. Mr. Adams will send a paper on this drug.

Subjects relating to Adulterations, Impurities, and Faults of Manufacture.

Iodide of Potassium. A large quantity of this salt is now imported from the Continent; what is its condition as to purity? Accepted by F. C. Clayton.

Carbonate of Bismuth of commerce is said to contain a large proportion of nitrate; what is the general composition of this article, and what the best method of its preparation in the pure state? Accepted by C. Umney.

Large quantities of cotton-seed oil are expressed in this country, and exported to Italy for admixture with olive oil. What are the properties of cotton-seed oil, and can it be used in pharmacy? Accepted by R. Reynolds.

Essential oils, their adulterations by turpentine, and tests of purity. Accepted by H. S. Evans.

Report on the purity of the simple and compound powders used in medicine. Accepted by F. M. Rimmington.

Report on the strength of diluted and undiluted officinal acids. Accepted by S. Paine.

Report on the strength of the alkaline solutions (Potash, Ammonia, &c.), met with in pharmacy. Accepted by S. Paine.

Report on the various James's Powders. Accepted by W. T. Fewtrell.

The composition of the bottled mineral waters of commerce. Accepted by H. Matthews.

On the Calamine and Oxide of Zinc of pharmacy. Accepted by R. H. Davis.

Report on the purity of commercial iodides and bromides, other than the iodide of potassium. Accepted by H. Matthews.

Report on the strength and condition of such mercurial preparations as mercury with chalk, mercurial ointment, &c. Accepted by J. Coupland.

Report on the purity of Sulphate of Quinine of commerce. Accepted by W. W. Stoddart.

Report on the strength of tinctures as met with in pharmacy. Accepted by W. D. Savage.

On the quantity of alkaloid in various specimens of citrate of iron and quinine. Accepted by T. B. Groves.

The Morphia salts of commerce. What is their state of hydration and moisture? Does the hydrochlorate often contain codeia? Accepted by W. E. Heathfield.

A committee of five gentlemen—Dr. Attfield, of London; Mr. T. B. Groves, of Weymouth; Mr. B. S. Proctor, of Gray Street, Newcastle; Mr. F. M. Rimmington, of Bradford; and Mr. F. Sutton, of Bank Plain, Norwich—has the general charge of these subjects relating to the purity of medicines. Either member of the committee will be glad to receive directly, or through the general secretaries, authentic specimens of substances whose examination would tend to throw light on the questions. The analysis of such specimens will be free of cost.

A committee to consider the subject of the prevention of accidental poisoning has also been formed. It is composed of Mr. J. R. King, of High Street, Bath; Mr. J. H. Marsh, of Milsom Street, Bath; and Mr. F. W. Kent, of Saville Row, Bath, either of whom will receive suggestions on the subject.

Every member of the British Pharmaceutical Conference is expected to suggest subjects for investigation, or to work upon subjects suggested by himself or by others, or to contribute information tending to throw light on questions relating to adulterations and impurities, or to collect and forward specimens whose examination would afford similar information, or in some other way to aid in the advancement of pharmacy. Any new facts that are discovered during an investigation may be at once published by an author at any meeting of a scientific society, or in any scientific journal, or in any other way he may desire. He is expected, however, to send a short report on the subject to the annual meeting.

The current list of subjects requiring investigation is sent to members immediately after their election, and a new list immediately after every annual meeting. The list for 1863-4, containing several questions at present unaccepted, can be obtained of either of the Honorary General Secretaries—Dr. Attfield, 17, Bloomsbury Square, London, E.C., and Mr. R. Reynolds, F.C.S., 13, Briggate, Leeds; or of the Local Secretary, Mr. J. C. Pooley, George Street, Bath.

The annual meetings will always be held in the provinces, and probably at the time and place of the visit of the British Association. Gentlemen desiring to join the Conference must be nominated by two members. The yearly subscription is five shillings, due in advance, on the 1st of July.

Death of Heinrich Rose.—We regret to announce the death of this distinguished analytical chemist. He died at Berlin, on the 29th of January, aged 69.

Royal Institution.—Tuesday, February 16, at three o'clock, Professor Tyndall, F.R.S., "On Experimental Optics." Thursday, February 18, at three o'clock, Professor Tyndall, F.R.S., "On Experimental Optics." Friday, February 19, at eight o'clock, W. S. Savory, Esq., F.R.S., "On Dreaming and Somnambulism." Saturday, February 20, at three o'clock, Professor Frankland, "On the Metallic Elements."

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E C.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

S. P.—Both notations are used. The price is 10s.

Magento will have some information on the subject next week.

J. Y. (*Glasgow*), should apply to Messrs. Simpson, Maule, and Nicholson.

J. D.—Next week.

W. L. Carpenter.—Received with thanks. The Report is postponed for woodcut.

A Young Student.—The atomic weights of the metals cannot be considered as yet settled. You had better be guided by the last edition of Fownes'.

Subscriber.—The amount of iodine in sea-water is inappreciable. Its presence therein is inferred from its presence in sea-weeds.

G. N.—The formulæ are correctly copied from the Report, in which the new notation is followed. In this notation the formula for water is H_2O, for phosphoric acid, H_3PO_4, and for sulphuric acid, H_2SO_4.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Non-Existence of Pyro- and Meta-Arseniates, *by* M. E. J. Maumené.*

It is said by Mitscherlich, that when acids and bases are combined in the same degree of saturation, they not only show the same crystalline form, but possess the same chemical properties. He has also asserted, that every arseniate has a corresponding phosphate, composed of the same proportions, combined with the same number of atoms of water of crystallisation, and possessing, at the same time, the same physical properties; in a word, the two series of salts differ in nothing but this—that the radical of the acid of one series is phosphorus, and of the other arsenic. This has been accepted as the expression of a natural law, and the most recent works on chemistry consent to this pretended law. "It is probable," say MM. Pelouze and Frémy, "that these salts (the arseniates) undergo, when heated, the same changes as the phosphates."

It is no such thing: arseniate of soda never gives either pyro-arseniate or meta-arseniate. Submitted to an intense heat, suddenly or carefully, or prolonged for some hours, it does not undergo the slightest change of the sort. Dissolved in water, and then mixed with a solution of silver, it always gives a brick-red precipitate of $AsO_5,3AgO$.

I prepared the acid by Gay-Lussac's method; this acid, neutralised with soda, and evaporated, gave, on cooling, a confused mass; after draining on a filter, and re-dissolving in water, the second solution, properly concentrated, yielded beautiful crystals of the formula $AsO_5,2NaOHO + 24HO$. These crystals heated to redness lost, in one experiment, 55·58; and in another, 55·87 per cent. of water. 25 HO corresponds to 55·97, and 24 HO would give 54·96 per cent. These results were verified by M. Setterberg.

The crystals were submitted to a full red-heat; the fused mass was dissolved, and the solution added to nitrate of silver. A precipitate of the well-known colour was produced, which, washed and dried, gave, on analysis, 74·1 and 74·3 per cent. of silver. $AsO_5,3AgO$ gives 75·1, and $AsO_5,2AgO$ would give 66·86 per cent. of silver.

Arseniate of soda fuses below 100° C.; kept at this temperature for a long time it becomes a gummy mass, which solidifies when agitated, and then is somewhat like stearic acid in consistence. I have kept the salt in this condition for several days, and at the end of the time have precipitated it with nitrate of silver. The arseniate of silver was brick-red, and yielded 75·11 per cent. of silver. The salt heated briskly to redness gave the same result—75·2 per cent. of silver.

I have maintained the arseniate of soda at a red-heat for several days in a glass furnace, and its properties have not been altered. To vary as much as possible the conditions of the experiment, I have employed the acetate in place of the nitrate of silver; but the brick-red precipitate always presented the same composition.

Arseniate of potash seemed to offer a chance of procuring meta-arsenic acid. I prepared this salt from an acid obtained by Gay-Lussac's method, and also from acid made from arsenious acid and aqua regia. The arseniate of potash was submitted to a red-heat, varying the conditions, as with the arseniate of soda, but the final results were constant, as before.

Lastly, the author experimented with the arseniates of baryta and lead, which, after the same treatment, gave a silver salt of exactly the same composition as was obtained with arseniate of soda.

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* Abstracted from *Comptes Rendus*, t. lviii., p. 250.

TECHNICAL CHEMISTRY.

On the Influence of Fluxes on the Composition of Manganiferous Cast Irons, *by* M. H. Caron.

In a recent note* I showed by experiments, supported by analyses, that manganese served, in cast irons, to expel sulphur, and often silicium; I added, that sulphurous and silicious cast iron might be improved by cast irons charged with manganese, which would be the more valuable according to their richness in manganese. Consequently, it would be well to possess means of extracting from the ore the cast iron most charged with this purifying metal.

There are two causes, all other things being equal, which singularly influence the amount of manganese contained in cast iron:—1st. The flux employed in the reduction of the ore. 2nd. The temperature at which this reduction is effected. I have ascertained the effects of these two causes by experiments, of which I will here give some description.

The ore on which I operated was a carbonate of iron and manganese, having the following composition:—

Carbonate of iron	71·0
Carbonate of manganese . .	13·3
Carbonate of magnesia . . .	11·2
Carbonate of lime	0·2
Silica (quartz)	4·3
	100·0

Several kilogrammes of this ore were finely pulverised and perfectly mixed together. In each of the assays, of which I shall give you the results, I used the same quantity of this ore; the wood charcoal mixed with the ore was in each instance used in the same way: finally, all the crucibles were brasqued with a mixture of graphite and molasses or coal-tar.†

The following table shows the kind and the quantity of flux used per cent. of ore, and the colour of the cast irons obtained, as well as their richness in silicium and manganese. In the experiments from Nos. 1 to 5, inclusive, the temperature employed for the reduction was always decidedly the same;—the temperature for No. 6 was as low as possible (high enough, however, to allow the cast iron to collect). In assay No 7, on the contrary, the heat must have been great enough to melt several hundred grammes of soft steel:—

No.		Colour of the cast iron.	Manganese per cent.	Silicium per cent.	
1. Carbonate of lime .	10	White	7·93	0·05	
2. Carbonate of lime .	5	White	6·32	0·08	
3. Fluoride of calcium .	5		4·70	0·30	
4. Silicious earth . .	5	Grey	5·81	0·55	
5. Silicious earth . .	10	Very grey	2·25	0·76	
6. Silicious earth . .	5	Grey	3·90	0·50	Low temp.
7. Silicious earth . .	5	Grey	2·10	0·75	High temp.

Assays Nos. 1, 2, 3, 4, and 5 show that, to obtain cast iron rich in manganese from a given ore, as much lime must be used as can be introduced without spoiling the fusibility of the slag. It will be found, on the contrary, that the proportion of manganese diminishes as the silicious flux increases, and what is remarkable, that, as the manganese disappears, silicium takes its place in the cast iron.

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* *Comptes Rendus*, 1861, p. 828.

† This brasque resists admirably, even in the reduction of manganese; but the graphite, before being used, must be freed from all foreign matters (about 4 or 5 per cent.), and especially from sulphur, of which it contains more than 1 per cent.

The temperature used for the reduction also exercises a notable influence on the richness of the cast iron in manganese. Assays 6 and 7 show that the higher the temperature the less manganese, but the more silicium, will be found in the cast iron. As in the preceding experiments, silicium and manganese seem mutually to exclude one another.

It will not be uninteresting to observe the nature of the cast irons obtained. A sufficient quantity of lime produces white cast irons, while silica produces grey. By simply changing the flux, we may then obtain it at will, either white or grey steel or iron, or cast iron.

I will not further enlarge upon these results; they are such as can be perfectly appreciated by metallurgists. I speak now of cast irons obtained with iron ores containing oxide of manganese or mixtures with it. Lime has not exactly the same influence on non-manganiferous ores; but the question should be treated in a special manner, and I trust soon to be able so to treat it.

The assays, the results of which I have laid before the Academy, are only laboratory experiments, but still I hope they may prove of some service. Thus, iron-masters who mix ores rich in manganese with their ordinary ores (sulphuretted or silicated), for the purpose of ameliorating their products, may without fear gradually increase the usual quantity of flux without seriously diminishing the liquidity of their slag. If the flux thus modified becomes too refractory, the addition of sea salt or chloride of calcium soon gives them the desired amount of fusibility.[‡] In this case, fluor-spar or cryolite[§] will produce the same effects; but as these bodies, especially the latter, always contain notable quantities of phosphoric acid, which is very destructive to cast iron, the greatest care must be taken in using them.—*Comptes Rendus*, lvii., 786. 63.

PHARMACY, TOXICOLOGY, &c.

The British Pharmacopœia.

(Continued from page 77.)

Having concluded a hasty review of most of the novelties introduced into the British Pharmacopœia, we proceed to notice the changes made in the various preparations, and on mature consideration take them in alphabetical order instead of classes, as at first seemed advisable.

We have noticed the substitution of French for British vinegar. The former article was already officinal in the Dublin and Edinburgh Pharmacopœias; and is, perhaps, better adapted for pharmaceutical purposes than vinegar made from malt, since it is less liable to change.

Acetic acid offers an example of the value of one Pharmacopœia for the United Kingdom. Under the three Colleges we had acids of eight different strengths prescribed. These have now been reduced to three—*Acidum Aceticum Glaciale*, *Acidum Aceticum*, and *Acidum Aceticum Dilutum*. Glacial acetic acid might as well have been omitted. Its employment in a single preparation (mist. creosoti) is a mistake. The acid will, no doubt, dissolve the creosote, but a separation will take place on the addition of the water.

The process given for the preparation of glacial acetic acid is of doubtful utility. Very careful experimenters inform us that they have failed to procure a crystallisable acid by the process; and, moreover, it could not be applied to the production of the article on any considerable scale. All the glacial acid consumed in this country is imported from the Continent, where it is produced at a cheaper rate than in this country. By what process it is made is not well known here; but we have reason to believe that that we quoted from the International Report (see page 58) is largely employed. At all events, a crystallisable acid is easily obtained by this process, which is besides very manageable.

Acidum Aceticum is still the purified pyroligneous acid, but the strength has been slightly diminished. The Dublin preparation, which has the sp. gr. 1044, and contains 28 per cent. of real acetic acid, has been adopted in place of the former London acid, which had the sp. gr. 1048, and contained 30·8 of real acid. For this acid pharmaceutists will have to rely on the manufacturers; and since the dilute acetic acid is now to be made with one part of acid to seven of water, it is to be hoped that Messrs. Beaufoy, the great producers of this article for pharmaceutical purposes, will at once increase the strength of their "one to seven" acid, to meet the requirements of the Pharmacopœia.

The new process for citric acid, the novelty in which consists in submitting the juice to fermentation before precipitating the acid by means of chalk, is one which we believe has long been followed by makers of the acid on a large scale. A good deal of the vegetable matter is got rid of by the fermentation, and the juice is clarified by the subsidence of the yeast.

This process, like a good many others, might as well have been omitted from the Pharmacopœia, the bulk of which is unnecessarily swollen by directions for the manufacture of articles which are found in commerce in a state of perfect purity. The same remark applies to the processes for benzoic and gallic acids, neither of which will be followed literally by any experienced maker of those acids.

The reader will observe that the strength of all the mineral acids has been altered. All the strong acids are to be made stronger, and the dilute acids likewise, with the exception of dilute sulphuric acid. The changes will be best shown by exhibiting the specific gravities in a tabular form :—

	London, 1851.		British, 1864.	
	Strong.	Dilute.	Strong.	Dilute.
Acidum Hydrochloricum	1·160	1·043	1·170	1·050
,, Nitricum . .	1·420	1·082	1·500	1·101
,, Sulphuricum .	1·843	1·103	1·846	1·087

We have already noticed the singular omission to direct the application of heat in the process for hydrochloric acid, which otherwise calls for no remark. The increase in the strength of nitric acid, from 1·42 to 1·5, is decidedly objectionable. The alteration appears to have been made because it was thought advisable to introduce a form for the preparation of gun-cotton, which might as well have been omitted; and perhaps, also, because the acid of the Dublin and Edinburgh Colleges was 1·5. Nitric acid of this strength is not easily prepared on the large scale, and the transport is dangerous, since, if a carboy should be broken, the straw surrounding it will almost inevitably become inflamed. The acid will probably be often made by re-distilling a weaker acid with sulphuric acid, than by the directions given in the

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[‡] By treating the residues of the fabrication of chlorine by carbonate of lime, a liquid will be obtained containing chlorides of manganese and of calcium. This liquid, freed by filtration or decantation from arsenic and phosphorus, and then dried, would be a valuable flux if it could be cheaply obtained.

[§] Fluor-spar and cryolite always produce a much larger yield of cast iron.

Pharmacopœia, where it is omitted to be stated that a retort capable of holding twice the amount of the ingredients should be employed.

In the preparation of sulphuric acid, the commercial acid is directed to be re-distilled with sulphate of ammonia. The object of this is to get rid of the nitrous compounds which are in general found in the commercial acid; lead will be found in the residue, and also any arsenic which may be present, the latter in the form of arsenic acid, that is, if nitrous compounds were originally present. On this point we may call attention to a paper in our last number. The distillation of sulphuric acid requires a great heat, and the operation can only be performed with small quantities at one time, and even then the liability to accident is very great. The process is unquestionably satisfactory; but such an acid as the Pharmacopœia contemplates will, no doubt, be oftener found in the laboratory of an analytical chemist than the store of a pharmaceutist.

The dilute mineral acids, as we have said, are all more or less altered in strength. They have, indeed, in one sense, been reduced to an uniform strength, that is, six fluid drachms of each now contain an equivalent in grains of the respective acids. We do not see the advantage of this, either to the prescriber or dispenser; but it affords a ready means of ascertaining the strength of the acid by the help of the volumetric method of acidimetry which is now applied in the Pharmacopœia, and which we may here refer to, so far as it is used in the determination of acids. Soda is very properly chosen to form the normal alkaline solution, which, after Mohr's system, is to contain one equivalent in grains (31) in 100 measures of the solution. The details of the operation we need not describe, since most of our readers must be acquainted with this method of analysis, and the directions of the Pharmacopœia are clear and intelligible.

Dilute phosphoric acid has been increased in strength, the new acid having a density of 1·08, while that of the old was only 1·064. In this instance six fluid drachms will only contain half an equivalent in grains of real phosphoric acid. A porcelain basin is now directed to be used in evaporating down the acid, a platinum vessel being quite unnecessary, unless the evaporation is to be carried much further than is directed in the Pharmacopœia.

The directions for the preparation of *Acidum Hydrocyanicum Dilutum* may be said to be identical with those in the London Pharmacopœia, and the acid is to be of the same strength, viz., with 2 per cent. of real acid. This, it is pointed out, is only little more than half the strength of the acid of the Edinburgh College—dilute hydrocyanic acid formerly meaning an acid with 3·8 per cent. of real acid on one side of the Tweed, and, on the other, with only 2·0 per cent. !

The strength of this acid is directed to be determined according to Liebig's method, by means of a normal solution of nitrate of silver, added to an alkaline solution of the acid.

Half a fluid ounce of the acid treated with an excess of soda should require 80·66 measures of the solution of nitrate of silver, which is to contain 17 grains, or $\frac{1}{10}$th of an equivalent, in 100 measures. Upon dropping the silver solution into the dilute hydrocyanic acid, rendered alkaline by soda, no permanent precipitate is produced until all the cyanogen of the acid has combined with the alkali and silver to form a soluble double salt, NaCy,AgCy. The smallest excess of silver beyond the quantity required to form this compound, occasions a permanent precipitate of cyanide of silver, the double compound being destroyed. The mixture must be constantly stirred as the silver solution is added, and the first appearance of permanent turbidity carefully noted.

We may here recommend all our readers to determine the strength of their *Aqua Laurocerasi* in the same way.

On the Relative Activity of American and European Aconite Root, by WILLIAM PROCTER, *Jr.*

AT the meeting of the Association held in Philadelphia September, 1862, the following query was accepted by me:—"What is the relative activity of the root of *Aconitum napellus* grown in the United States and that imported from Europe, based on their yield of aconitia; and what objections, if any, exist to the economical culture of the plant in the United States." Soon after the meeting adjourned, a letter was addressed to Messrs. Tilden and Co., of New Lebanon, New York, who cultivate aconite for making the extract, requesting their aid in obtaining a sufficient quantity of the American grown root, to make the comparison. The very early setting in of the winter interfered with their getting the root, and it was not until early spring, when the frost left the ground, that they could have it gathered. It was then carefully dried. The quantity received was rather more than a pound avoirdupois. So carefully had the roots been removed, that the fibres were mostly remaining; the main roots varying in diameter at the caudex from a quarter to three-quarters of an inch, and from three to six inches in length, including the tap root. The colour of the epidermis is purplish brown, inclined to black on the older portions, and the odour is rank, and somewhat like that of opium.

After carefully drying the aconite it was ground to moderately fine powder. 5000 grains of this were macerated for two weeks,* in sufficient alcohol, sp. gr. ·835, to moisten it, then packed into a glass percolator, and slowly percolated with alcohol until five pints of tincture had passed. The percolate was placed in a retort, and, by aid of a water-bath, four pints of alcohol were recovered, and the residue evaporated to four fluidounces. To this a fluidrachm and a half of diluted sulphuric acid mixed with a fluidounce of water was added, and the whole evaporated to two fluidounces and a half. The residue was syrupy in consistence, with oleoresinous globules floating on it, with a decided acid reaction. The aconitia being in the state of sulphate, and hence insoluble in strong ether, the liquid was agitated with two fluidounces of washed ether to remove the oleoresin; after decanting, the washing was repeated. The aconite liquor was now treated with an excess of solution of ammonia to liberate the aconitia, and the alkaline mixture washed by agitation and decantation with three separate portions of ether, of two fluidounces each. The ethereal liquids, united, were evaporated spontaneously in a tared capsule: the residue weighed sixty grains, and was dark coloured, strongly alkaline and not entirely hard, owing to a little oleoresin present that had not been completely removed by the preliminary washing. The impure mass was mixed with a fluidounce of distilled water, and diluted sulphuric acid carefully dropped in, with the application of heat, until the acid ceased to be neutralised, and the liquid remained slightly acid. A residue of dark brown oleoresin remained. The fact of this occurring shows the importance of well washing the solution before separating the aconitia. The solution of impure sulphate of aconitia was now filtered, and the filter carefully washed. The filtrate weighed 585 grains troy. To ascertain the aconitia strength of this liquid, it was assayed by the process of Prof. F. F. Mayer (*Amer. Jour. Pharm.*, vol. xxxv., p. 23), with iodohydrargyrate of potassium. Five grains of this solution diluted, required sixty-eight grains of the test liquor, a preliminary trial having been made to get an idea of the strength of the solution. Then as 68 grains of test liquor represent ·36312 grains of aconitia present in 5 grains of the solution of sulphate of aconitia, therefore 585 grains equal 42·483 grains of aconitia from 5000 grains of the root, or nearly 0·85 per cent. (585 ÷ 5 = 117 × ·36312 = 42·483).

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* This long maceration was rather accidental than intentional.

The residual liquor, after the extraction of the aconitia, was then treated with an ounce of chloroform and a little more ammonia; but, owing to the ether present and the density of the extractive solution, it did not separate. To effect its separation, sufficient ether was added to make the mixed chloroform and ether lighter than the extractive solution, when it was decanted, evaporated, and heated with a fluidounce of water. The addition of diluted sulphuric acid liberated a bulky hydrated oleoresinous precipitate, which, on standing, gradually lost its water of hydration, and assumed a soft consistence, staining paper. The liquor from this precipitate, with its washings, was tested for aconitia, and 4·065 grains more of the alkaloid indicated, making the whole, according to Mayer's test, 46·56 grains.†

European Aconite Root.—A parallel experiment was now tried with European aconite root of German origin; 5000 grains of this root, in moderately fine powder, were treated in a similar manner with alcohol, sp. gr. ·835. The liquor concentrated to three fluidounces, mixed with a quantity of diluted sulphuric acid, equal to that employed in the first experiment, and then washed with ether until the latter ceased to be coloured. The aconitic liquid separated from the ether was mixed with an excess of ammonia, and again treated with ether till exhausted. The ethereal liquids left, on evaporation in a capsule, 30 grains of soft brown residue strongly alkaline to test paper. This, when treated with a fluidounce of water, and sufficient diluted sulphuric acid, all dissolved but a trace, showing that the more thorough preliminary washing in this instance had removed all the oleoresin. The impure solution of sulphate of aconitia weighed 686 grains. Five grains of this required 30 grs. of test liquor to saturate it. 686 ÷ 5 = 137 × 0·1602 = 21·94 grains.

The residual aconite liquor was treated with chloroform, ammonia, and ether, as in the other experiment. A few grains of soft extract only were obtained, exhibiting, when properly treated, but a faint cloudiness with the test solution for aconitia.

The ethereal washing liquids, containing fixed oil and resin, were separately evaporated. The product from the American root amounted to 114 grains; whilst that from the European root equalled 180 grains.

The two solutions of sulphate of aconitia were now treated to isolate the alkaloid. That from the European root was carefully precipitated by ammonia, the precipitate collected on a filter, washed and dried. It weighed ten grains.

The solution from the American root was then precipitated by ammonia, and the liquid and precipitate washed with ether to remove the aconitia. The ethereal liquid, on evaporation, left the aconitia somewhat gelatinous, and, on standing, decided evidences of crystallisation were manifested. Most of the alkaloid dried in a resin-like form of a yellowish colour, which, in powder, had a light straw colour, and weighed 21 grains.

Aconite has fewer enemies among the insect tribes than any of the ordinary narcotics or sedatives, not being preyed on by the slug, so destructive to hyoscyamus and belladonna. The soil should be deep, and well manured with animal manure, and the plantation kept clean. The roots should be dug late in the fall, and then thoroughly dried.

From the foregoing parallel experiments, it would appear that aconite roots grown in America are stronger in aconitia than are the commercial European roots. The sample of European aconite used was, so far as could be judged by external appearance, a fair specimen, and, medicinally, had given satisfaction. In all the papers that I have examined, from that of the discovery of aconitia by Brandes, about 1821, to that of Geiger and Hesse, in 1832, and Von Planta, 1852, none give the percentage strength of aconite root, and hence I have no data to decide upon the normal percentage of the drug. The experiments were conducted with entire fairness, and as nearly parallel as is usual in such investigations. —*Proc. Amer. Pharm. Assoc.*, 1863.

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture V.—*Thursday, January* 7, 1864.

Ladies and Gentlemen,—I have a few remarks yet to make to conclude the subject of dolomite, after which we shall proceed at once to the silicates.

There is one curious point with regard to dolomite, namely, that from a water containing carbonate of magnesia and carbonate of lime, held in solution by excess of carbonic acid, the carbonate of lime is precipitated as the excess escapes without being accompanied with any sensible amount of magnesia. This has been experimented upon by Bischoff and others: the Carlsbad waters, for example, which contain a notable amount of magnesia, let fall a deposit of carbonate of lime free, or almost free, from magnesia. On the other hand, if heat be applied to a solution of this sort, the deposit contains a sensible amount of magnesia. Thus, Mr. Sterry Hunt, to whom we are indebted for information on many points of importance in the application of chemistry to geology, found that an artificial water containing chlorides of calcium and magnesium, with bicarbonates of these bases, deposited by spontaneous evaporation a substance which contained $\frac{8}{10}$ths of carbonate of lime without any carbonate of magnesia. The same water, on the application of heat, let fall a deposit which contained 0·666 of carbonate of lime and 0·173 of carbonate of magnesia.

I have now laid before you a succinct account of the various theories which have been proposed to explain the mode of formation of dolomite. Two questions were especially proposed for consideration: the first is,—Has dolomite been deposited as such? The second is,—Has dolomite resulted from chemical action upon beds previously deposited—upon sedimentary beds? With regard to the first question, the only direct experiment in which dolomite appears to have been satisfactorily made, is that of Favre and Marignac, which consisted in heating carbonate of lime in a solution of chloride of magnesium in a closed glass tube, at 200° centigrade; but nothing like proof is advanced in favour, even of the probable occurrence of these conditions, and of this temperature in nature—at least, over a large area, and at the period of the formation of dolomite. As magnesia has a strong tendency to form double salts, many of which are very well known, and can be easily made, several methods would obviously suggest themselves to chemists as likely to produce dolomite of definite composition, but I believe all these have been tried and have hitherto been found unsuccessful.

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† The reader will observe that Prof. Mayer's test indicates twice as much aconitia as was obtained by experiment. I am unable to account for this, unless by inferring an error in Prof. Mayer's numbers.—W. P., Jr.

The first question, then, so far as chemists are concerned, must be left unanswered for the present. It is a question which well deserves the attention of our chemists. With regard to the second question, whether dolomite has resulted from chemical action on sedimentary beds—of course I allude to carbonate of lime—it appears certain that in many cases it has been so produced. I need not recapitulate the evidence which has been advanced upon this point. That evidence rests upon geological observations; and although several chemical hypotheses have been put forth as to the *modus operandi*, yet they are unsupported by direct chemical proof. That limestone has in many instances been changed into dolomite there can be no doubt, nor can it be doubted that the change has been effected by the infiltration or percolation of water containing some magnesian salt or other. One of the most important and decisive observations, as it appears to me, leading to this conclusion, is that of Dana, concerning the comparatively large percentage of carbonate of magnesia in certain fossil corals. A clue is thus afforded to one method by which carbonate of lime may, in the course of time, become dolomite; and that is, by the action of the magnesian salts in sea-water at ordinary temperatures. Pseudomorphs of dolomite after calcspar, of which we have fine specimens in the museum above, furnish another strong argument in favour of the possibility of the transformation of carbonate of lime into dolomite in a similar manner. It is not, however, absolute proof, for it might be urged that the calcspar or carbonate of lime crystals had been first removed by aqueous action, leaving a mould which may have been subsequently filled with dolomite. Again, the more or less complete obliteration of fossils in certain limestone beds, which gradually pass into dolomite, is another argument in support of the partial replacement of carbonate of lime in limestone by an equivalent proportion of magnesia. This accumulation of arguments, I think, leaves no alternative but a positive answer to the second question. The hypothesis of magnesian vapour is, I venture to assert, purely on chemical grounds, one of the wildest and most unfounded ever suggested. Surely, before such a hypothesis was propounded, some reason should have existed for supposing that oxide of magnesium could be volatilised. There is, however, direct and positive experimental evidence that magnesia is perfectly fixed at the highest temperatures we can command in our furnaces and otherwise; and so far as we can judge from experiments as to the temperatures required to melt even the most refractory of the so-called igneous rocks, there is no ground for supposing that nature has employed, in the melting of these rocks, temperatures much greater than are necessary to effect their fusion. The mistake is often committed of confounding quantity of heat with intensity of heat. A pound of basalt requires for its fusion as high a temperature as a mountain of the same material, and we can melt basalt with much facility even in our common furnaces. But allowing that magnesia could be melted, as supposed, that would not explain the transformation of limestone into dolomite by the action of magnesian vapour; for in any case, the existence of this vapour necessarily involves the supposition of the exposure of carbonate of lime to an extraordinarily high temperature, and, consequently, the existence also of enormous pressure. However, admitting the concurrence of these conditions, how is the condensed magnesia to be converted into carbonate? There is not a shadow of chemical evidence in support of this extravagant and most unchemical hypothesis. That dolomite has been formed by the agency of liquids under very ordinary conditions, I have little doubt will be hereafter fully established by direct and indisputable chemical evidence.

We now proceed to the examination of the silicates—an extremely interesting and important class of bodies.

Silica, apparently so inert at ordinary temperatures, developes powerfully acid properties at high temperatures, readily displacing from combination even the strongest acids, such as sulphuric acid.

The silicates constitute a very large number of natural minerals which, variously intermixed or associated, compose our so-called igneous rocks. There are two classes of silicates—the anhydrous and the hydrated, or those which do not contain water and those which contain water. The anhydrous silicates are produced directly by igneous action, and the hydrated silicates are produced by aqueous or, as I may term it, thermo-aqueous action, or, if you please, hydro-thermic action, implying the operation of water at high temperatures under great pressure.

The silicates produced by igneous action may be directly formed by heating silica and the base together. We can make silicates without the least difficulty in this way. I have laid before you a numerous series of specimens so formed. Combination may take place without the least appearance or least evidence of fusion. That is an important point. Here is a silicate of oxide of cobalt, which is largely prepared for manufacturing purposes. It was made by mixing silica and oxide of cobalt together, and heating the mixture for a long time at a temperature very considerably below that which would suffice for the fusion of the silicate when formed. We have here other silicates so produced. When they leave the crucible they come out apparently as pulverulent as the mixture when first introduced. Here is a specimen—silica and lime heated together. It is perfectly pulverulent, and yet we know that combination has taken place, for if we apply an acid to it, the lime is removed, and the silica is separated, not in the form of sand or powder, but in the form of a jelly, which is a certain proof that the silica has been in a state of combination. There is some silicate of lime which has been treated with an acid, and you will observe there the flocculent silica which has been deposited. From this example we see that combination may take place without any sign of fusion, and this affords an example of the fallacy of the old adage about bodies not acting except when dissolved,—"*Corpora non agunt nisi soluta.*" This principle of forming silicates by exposing them to a temperature insufficient to cause fusion, is much resorted to in manufacturing operations, as, for example, in the production of certain kinds of glass. It is called "fritting." Supposing we have a silicate consisting of a very fusible base—oxide of lead, for example,—if we heat a mixture of the components to a high temperature, the oxide of lead will melt and subside, and the surface of contact between the lead and the silica being greatly diminished, the lead will be protected to a great extent from the action of the silica. But if, on the other hand, fritting be resorted to, that is, if we keep the two bodies at a lower temperature than is required to fuse them, extensive contact is preserved, and we then succeed much better in producing such a silicate. The amount of contact is much greater than it would be if the oxide of lead were allowed to fuse and subside to the bottom of the vessel. After combination has been effected by means of fritting, the temperature may be raised in order to melt the product.

We come now to the consideration of the physical properties of the silicates. The most familiar examples of silicates are presented to us in the form of glass, of which there are several varieties; for instance, crown or common window glass, bottle-glass, and flint-glass—glass which contains a large amount of oxide of lead.

We may divide the silicates into two distinct classes

There are, first, the amorphous, or formless silicates; and these, again, we divide into two classes or divisions—firstly, the vitreous or glass-like silicates; and, secondly, those which are opaque and stone-like, and are not vitreous in their aspect. The second class of silicates includes those which are crystallised.

As I said just now, the various kinds of common glass are familiar examples of the vitreous silicates. Crown-glass and bottle-glass are silicates of soda and lime. Flint-glass, on the contrary, is a silicate of potash and oxide of lead. We have here very beautiful specimens of zinc glass, oxide of zinc in this description of glass replacing oxide of lead. In nature we find a beautiful kind of glass—obsidian. It is a black glass, which, in thin slices, is translucent, and does not exhibit much colour. The colours of the glass which we produce in commerce are due to the presence of metallic oxides in small quantity. There is red glass, the colour of which is due to dioxide of copper. A yellow glass has been manufactured of late, the colour of which is imparted by oxide of uranium. Blue is due to oxide of cobalt; purple, to oxide of manganese; and black, to mixtures of various oxides, especially iron and manganese. There is one point in connection with black glass to which I must call attention. We have a specimen in the museum, which came out of the Exhibition of 1851, from the French department. It is an intensely black glass. M. Dumas assured me that the black colour was communicated entirely by sulphur. In iron furnaces there are slags which are intensely black, and there are reasons for supposing that sulphur in certain combinations—probably as a sulphide—may communicate the black colour to them.

The next point to which I shall refer is one of considerable interest, and especially, I think, to geologists. It is the subject of devitrification, or the crystallisation of glass. If we take a piece of ordinary glass—common bottle glass, for example—and expose it for a long time to a red heat—we will say a temperature quite insufficient to melt it—it will become perfectly opaque. If we continue the heat long enough, it will cease to present the slightest appearance of vitreous character, and will be converted into a stone-like mass. In other words, it will become crystallised, or devitrified. Again, if we melt glass, and allow it to cool very slowly, the same phenomenon occurs. I have here a very extensive series of specimens, which I have collected from time to time, illustrating all these points, and they are well worthy of your examination. There is a piece of common crown glass. When that is heated and slowly cooled, you will find that beautiful little radiated crystals will start up through the mass in all directions. These will gradually enlarge, forming globular masses, which at length will become so considerable as to occupy the whole mass. It is very beautiful to watch the changes that take place in glass of this kind. There is another specimen in which you will see a number of globular white masses, each being a series of radiating white crystals. Here again is a larger specimen. It is very curious, in the case of bottle glass, to see the change of colour consequent on the crystallisation. Here is a piece of ordinary bottle glass which has become opaque and acquired this blue coloration simply by being heated in the manner described. This reddish brown portion is the crystallised portion of it. It consists of large nodular masses formed of radiating crystals. Then again we find that these crystals are arranged in rows or definite layers, reminding one very forcibly of a certain kind of obsidian—Lipari obsidian. These specimens are nothing more than pieces of ordinary glass converted into a crystalline form in the manner I have described. If I were to take this piece and expose it to a high temperature, and cool it rapidly, I should get glass again just in the same state as it was before. If we take igneous rocks, pound them, melt them down, and cool them slowly, we get a mass like that—opaque and crystalline; but if, instead of cooling the melted rock slowly, we cause it to cool rapidly, we get a mass of a vitreous character. We frequently find in the slags of our furnaces that one portion of them is vitreous and the other portion crystalline. Other things being equal, that part which cools most rapidly will always acquire a more vitreous character than the other part. Hence it is, that on the outside of these pieces of slag you find a glassy appearance. Here is a very beautiful specimen of crown glass, in which you will see crystals of large size. I may direct your attention to the case in the museum above, which contains numerous illustrations of devitrified glass. Here is another beautiful specimen—the only one of the sort I ever saw. I had it from Mr. Bontemps some years ago. It is flint glass—silicate of potash and lead—and is in beautiful crystals.

In this process of devitrification, there may be a simple rearrangement of particles in a crystalline form. We may, for example, have a definite chemical silicate; that silicate, if cooled rapidly, may be a glass, or, if cooled slowly, it may be a mass of crystals. On the other hand, we may have a mixture of silicates; and, on cooling, one of these shall crystallise out, producing a more or less definite crystallised silicate, and there shall remain a portion non-crystalline—a sort of "mother-water" of glass, if I may apply that chemical phrase to this subject; and thus, when we come to examine the non-crystalline portion in certain cases, and compare the constitution of that with the crystallised portion, we find a difference. This is exactly what takes place in ordinary solutions. There is no reason why the same thing should not occur—as it does occur—in the case of glass. The question has been examined by Terreil. An attempt has been made to employ our basalt, occurring in South Staffordshire, along the line of the Rowley Hills, on a large scale, for manufacturing purposes. The Messrs. Chance took out a patent, some years ago, for this application of basalt. It was proposed to melt it, cast it, and then cool it; and I have seen some articles so produced—such as the lintels of doors, and so forth; but, owing to some difficulties which arose, the process was ultimately abandoned.

Let me now direct your attention to certain accidental forms of silicates. I think there are some points in connection with this part of the subject which may interest geologists especially. Silicates are largely produced in our iron-smelting furnaces, and sometimes you will find, in looking over the cinder heaps, that these silicates are present in a variety of peculiar forms. Here is a specimen I got from Staffordshire some years ago. It is remarkably cellular, resembling honeycomb; and the cellular structure exists throughout a large mass in this instance. It could only be formed, I think, by the elimination of some gaseous matter from every part of the slag during solidification. Then there is another form in which the slag is found—that of hair-like threads. This is some from South Wales. It is a delicate, wool-like substance. I have also some from Prussia. It is a slag of by no means uncommon occurrence. It is nothing more than delicately spun glass—filaments of glass which have been spun by the operation of the blast. The blast has, in some way, caught the slag, and spun it into delicately hair-like threads. On examination, you will find little globules of glass occurring here and there among the threads. I mention this form particularly, because nature presents us with similar products—in fact, so similar, in all respects, that if you place the two together you will hardly be able to distinguish them. I believe we have in the museum above some volcanic specimens of this sort. I will give you a statement of Dana on the subject of this capillary volcanic glass, which he observed at Kilauea, in the Pacific Ocean. "At one of the pools, the formation of Pelé's hair, or capillary volcanic glass, was in progress. It covered thickly the surface to leeward, and lay like mown grass, its threads being parallel, and pointing away from the pool. On watching the operation for a moment, it was apparent that it proceeded from the jets of liquid lava thrown up by the process of boiling. The currents of air blowing across these jets bore off small points, and drew out a glassy fibre, such as is produced in the common mode of working glass. The delicate fibre floated on till the heavier end brought it down, and then the wind carried over the lighter capillary extremity. Each fibre was usually ballasted with the small knob which was borne off from the lava-jet by the winds."

If you will take the trouble to examine this specimen, and compare it with the specimen above, I think you will see that the two are so nearly identical in all essential respects that they might easily be confounded with each other.

We now come to the subject of the fusibility of silicates. What is required to affect fusion in many cases is not so much an extremely high temperature as long-continued heat. There are some which do, of course, require very high temperatures, and which resist even the highest temperatures we can command in our furnaces.

The silicates are sometimes excessively liquid when fused; at other times they are more or less viscous; and this is especially the case with the slags or cinders from our blast-furnaces. If you examine the operation of these furnaces, you will detect a little delicate lava stream. There may be no outward sign of such a stream, the whole being covered with solid slag, but upon pushing a walking-stick through the upper portion you will render visible a little current of molten slag beneath. In these slags when melted you will occasionally find a considerable quantity of unfused and suspended matter mechanically present. In a slag obtained from our copper furnaces, called "ore furnace slag," you will always find a quantity of quartz diffused through the mass. Here is a sample. The quartz forms no part of the constitution of this slag, but is there simply mechanically. The presence of such matter can easily be accounted for in natural lava. A lava stream may in its course come in contact with foreign matters, take them up, and transport them to a distance, and on that account I present this specimen before you as an illustration of what occurs in nature.

Now, with regard to the composition of silicates. We may have simple silicates, perfectly definite in atomic constitution, consisting of one single base, and silica. Of these there are two distinct classes. There is that represented by the RO base, as chemists term it. That is the base which is typified, we will say, by lime, or magnesia, or protoxide of iron, or protoxide of manganese. And then we have the other kind of base, which is represented thus—R_2O_3, and which is illustrated by alumina, for example. We might have a silicate of lime. That would be a simple silicate—a silicate consisting of one equivalent of base and one of silica. The same remark applies with regard to the other kind of base. We have definite silicates containing each of the two types of bases. Thus, our common iron furnace slag, of which you have numerous specimens before you, consists of silicate of lime and silicate of alumina. Here is one which is a definite chemical compound—silicate of lime and alumina. It contains, however, a small quantity of foreign matter mechanically present. Then we have mixtures—and this is a point of importance—of definite silicates with each other,—not *compounds*, but simple *mixtures*; and these occur abundantly in nature. Lastly, we have definite silicates or mixtures containing foreign matter. The ore furnace slag which I exhibited to you just now is an example. This foreign matter may either be perceptible to the eye, as in the case of that slag; or it may be minutely diffused through the mass, and invisible, as it is in the case of this slag.

We will examine various definite silicates occurring in nature—silicates known to occur in nature, but which have been produced artificially.

The first of these is wollastonite, or tabular spar, which crystallises in the oblique system. This wollastonite is a compound essentially of lime and silica, and the oxygen of the silica is exactly double that of the lime; so that, taking the old method of notation with respect to silica, the chemical formula will be $3CaO,2SiO_3$,—three equivalents of lime, and two of silica. That gives three equivalents of oxygen with the lime, and six with the silica. Wollastonite may be formed by strongly heating lime and silica together in certain proportion. Here is a specimen of the natural wollastonite from America; and here is a specimen of the artificial mineral prepared here some years ago. These specimens require to be looked into carefully with a magnifying-glass. There are cavities here which are filled with this wollastonite. Here is another specimen, on the surface of which you will see very distinct evidence of crystallisation. There is no doubt whatever about our being able to form this substance by the direct union of the constituents. I have obtained it occasionally pretty well crystallised. Daubrée informs us that he has produced wollastonite by the action of water at a high temperature on glass. The temperature was 400° centigrade, requiring, of course, a correspondingly great pressure. The alkaline silicate dissolves, and an opaque residue of the glass is left. This residue is not amorphous, but consists, according to Daubrée, of very fine, acicular crystals. After separating, by levigation, the associated minute crystals of quartz formed at the same time, he analysed the residue, and found it to contain

Silica	53 per cent.
Lime	46 ,,
	99 ,,

There were also traces of magnesia. According to the formula I have given, the calculated composition of the natural mineral is—

Silica	52·38 per cent.
Lime	47·62 ,,
	100·00 ,,

On comparing these two analyses, notwithstanding the slight difference between them, there is no doubt about the identity in composition of these two bodies. We have, then, facts to show that wollastonite may be formed directly by igneous action, without the aid of water; and we have the facts alleged by Daubrée to show that it may be formed by the action of water at a high temperature on silicate of lime and soda, that being the composition of glass. According to Bischoff, wollastonite is very easily decomposed by water containing carbonic acid, with the formation of carbonate of lime, and the separation of silica. In some analyses of the native mineral, we find a little carbonic acid and water put down, though in small quantity. Wollastonite in nature accompanies garnet, fluor, and native silver, in limestone, at Pargas, in Finland, and at Kongsberg, in Norway. It occurs in basalt, along with prehnite, at the Castle Rock, Edinburgh; at Ceylon, with garnet in gneiss; at Auerbach, in crystallised limestone and gneiss with garnet, epidote, magnetic pyrites, and iron pyrites (FeS_2). The iron pyrites is in a finely divided state, but in such proportion as to render useless the rock, which would otherwise be valuable as a marble. Wollastonite is also present in matter ejected from Vesuvius at Fossa Grande, and in lava at Capo di Bove, near Rome; at the side of a vein of garnet and gneiss in New York County; and it is found with garnet and felspar, and garnet and quartz.

The next mineral which I shall describe to you is chrysolite, or peridot. This is a silicate of magnesia, in which the oxygen of the silica is exactly equal to that of the magnesia. The formula is $3MgO,SiO_3$,—three equivalents of magnesia and one of silica. These bodies can be combined directly by exposing the mixture to a high temperature, but the product has not been obtained well crystallised by that means. The result has been, an imperfectly-fused, white, hard, porous mass. However, by the addition of boracic acid, Ebelmen succeeded in producing very good specimens of chrysolite. There is some chrysolite produced by Ebelmen himself. He mixed magnesia with silica in proper proportions, and added boracic acid, which simply played the part of a solvent at a high temperature. The mixture was exposed to a great heat in a porcelain furnace, and the boracic acid evaporated, leaving chrysolite in a crystalline form.

Iron chrysolite, or chrysolite in which the magnesia is partly or wholly replaced by oxide of iron, is a frequent constituent in our furnace slags, and occasionally we obtain magnificent specimens of it. Here is a specimen most beautifully crystallised. Iron chrysolite varies very much in composition, the magnesia being replaced more or less by oxide of iron. In nature we find some of these varieties very rich in protoxide of iron. Here is a specimen in which magnesia is, practically, wholly replaced by protoxide of iron. It has, however, the crystalline form of chrysolite, and has the same formula precisely. We can produce it, and have produced it, by heating together silica and protoxide of iron, or a certain compound capable of yielding protoxide of iron at a high temperature. There is no difficulty in obtaining it well crystallised on a small scale. It crystallises in the prismatic system. This mineral occurs in lavas, in basalt, in obsidian, and in greenstone. It is present also in meteoric iron, being found, for example, in Pallas's famous meteorite, and in the well-known meteorite from Atacama, in Peru. But how to explain this fact is, I confess, a puzzle to my mind. How it comes to be so uniformly diffused through such masses of crystalline iron—for it is always well crystallised—it is difficult to explain at present. Iron chrysolite frequently contains oxide of nickel in small quantity.

When exposed to a bright red heat for some time, iron chrysolite takes up a certain amount of oxygen. In fact, by continuing the heat, you can at length convert the protoxide of iron into peroxide of iron. I can show you crystals which have been treated in that way. Here are some. In fact, these crystals are pseudomorphs.

I shall now direct your attention to the mineral augite, or pyroxene—a well-known mineral, crystallising in the oblique system. The relation between the oxygen of the silica and that of the bases in pyroxene is exactly the same as in wollastonite; but, instead of the base consisting only of lime, as in that mineral, the lime is replaced by variable proportions of magnesia, protoxide of iron, and protoxide of manganese. Alumina is also frequently present. If you were to collect all the analyses which have been made of augite, you would find them very variable; yet they all may be referred to this simple formula, $3RO,2SiO_3$, or RO,SiO_2. The two minerals, augite and wollastonite, are not chemically distinct. We have a light-coloured variety of augite containing chiefly lime and magnesia; and we have a dark-coloured augite, containing much protoxide of iron. This mineral is produced in the slags of furnaces. Here is a specimen which I obtained many years ago from the Olsberg furnaces on the Rhine. These crystals have been examined by Professor Miller, of Cambridge; but they were not sufficiently distinct to give him definite information as to their system. They, however, evidently resemble crystals of pyroxene. They have the same formula, and contain—

Silica	53·37
Alumina	5·12
Lime	30·71
Magnesia	9·5
Peroxide of manganese	1·41
Peroxide of iron	0·95
	101·06

There is no doubt about the identity of this with certain forms of minerals occurring in nature. This is a remarkably well crystallised specimen of pyroxene from slag. I have never seen a better. We have proof positive that this mineral can be formed, and beautifully crystallised, by heating directly together the constituents—lime and silica. Daubrée tells us that he has made it by the action of the concentrated mineral water of Plombières on glass. The variety obtained by him resembled the mineral diopside which occurs in nature. Pyroxene occurs in volcanic and certain crystalline rocks. It is associated with garnet and talc in veins traversing serpentine; and it occurs in limestone and certain dolomites.

The next mineral we come to is amphibole or hornblende. The system of crystallisation is the same as that of augite; the angles, however, differ. The composition may be the same, but it is equally variable. The two minerals differ, essentially, then, in crystalline system, and nothing more. By fusion, amphibole or hornblende may be converted into augite. This has been proved by the experiments of Berthier, Mitscherlich, Gustave Rose, and Rammelsberg. The varieties of this mineral occurring in nature are very numerous. Among them may be mentioned tremolite, actinolite, asbestos, and pargasite. Amphibole occurs as a chief constituent in the rock called syenite. Light varieties occur in granular limestone, dolomites, granite, and in the marble of Glen Tilt.

Garnet is the next mineral to which we shall direct attention. It crystallises in the cubical system. We have many well known and beautiful forms of garnet. It is very often an ornament of our mineralogical cabinets.

I shall direct your attention especially to the formula of garnet, because it bears a striking relation to the formula belonging to a substance continually produced in our furnaces, and also occurring in nature. The formula of garnet is—$3RO,SiO_3+R_2O_3,SiO_3$ or $3RO,2SiO_2+R_2O_3,SiO_2$. It consists of three equivalents of a base of the RO type, represented by lime, but one equivalent of the lime may be replaced by other isomorphous bodies, such as protoxide of iron, or protoxide of manganese. If you calculate the oxygen of the silica, you will find it exactly equal to the oxygen of the base; and the oxygen in the one series of bases bears the same relation to that of the silica as the oxygen in the other.

Many attempts have been made to produce garnet directly, but none have succeeded well, no good crystals having been obtained. However, some time ago a mineral collector came to me with some specimens from the Monkland iron furnaces in Scotland. Being always very curious in looking after these matters, I perceived immediately something like garnet among the specimens. Here are some of the crystals. They are so small that it would be perfectly useless to attempt to analyse them. They have the precise crystalline form of garnet. They have been very carefully examined by Professor Miller, of Cambridge, and they have been found to be crystallographically similar to garnet. These are probably the best crystalline specimens of artificial garnet ever found. M. Studer is reported to have made garnet directly by fusing together its constituents.

The next mineral with which we shall deal is humboldtilite or mellilite. It is one which has been produced artificially on a large scale. It is constantly produced in our blast-furnaces. It is essentially a silicate of lime and a silicate of alumina, the lime being replaced more or less by magnesia, protoxide of iron, or protoxide of manganese. We have only to double the silicate of lime in the last formula, and we get the formula of humboldtilite—

$$2(3CaO,SiO_2)+Al_2O_3,SiO_2.$$

The oxygen of the silica of this mineral is exactly equal to the oxygen of the bases; but the oxygen of the lime series is exactly double that of the alumina series. The native mineral occurs crystallised only in small crystals.

Here we beat nature hollow. I place before you specimens of humboldtilite which are identical in composition with the natural mineral, but the crystals are four or five times as large as any found in nature. I have been for many years looking after these specimens, but I have never found any equal to some which I obtained many years ago in South Staffordshire. The form of the crystal is a square prism. We find it beautifully crystallised in our slags, but generally without any modifications. Here you have modifications, the angles being replaced by planes. The crystals are translucent, and possess considerable lustre. This mineral occurs in the lava of Vesuvius, and at Capo di Bove, with nepheline. As I said just now, we beat nature hollow in the size of the crystals of this particular mineral, though, I must say, she has the advantage with regard to a great many other productions.

The next mineral to consider is gehlenite. We have found this mineral produced artificially once, and once only. I was fortunate enough some years ago to procure one specimen, but only one. None have been obtained since. Here it is. It is not very much like the natural mineral externally, but it is still identical with it in formula. I analysed this artificial mineral some years ago, and Professor Miller, of Cambridge, has carefully examined its crystallographical and physical properties. We suggested a new formula for it; and, at the same time, Rammelsberg, from experiments he was making with the natural mineral, actually suggested our identical formula. The formula is this—$3(3CaO,SiO_3)+3Al_2O_3,SiO_3$. You will now see its relation to the formula of humboldtilite. Gehlenite occurs in the Fassa Thal, in Tyrol, and in crystals embedded in calcspar in syenite. All these crystals before you contain impurities which in no way enter into the composition of the mineral.

We next come to felspar, or orthoclase, or potash felspar. Felspar has the formula $KO,SiO_3+Al_2O_3.3SiO_3$. It is essentially silicate of potash and silicate of alumina, and exactly resembles in constitution, or, at all events, is equivalent in constitution to common alum, if you replace the sulphuric acid by silica. It is a silicate of potash, in which the oxygen of the silica is three times as much as that of the potash, and that of the silica with the alumina three times as much as that of the potash. It was found, in 1834, in the Sangerhausen copper furnaces, near Mansfeld. When they were breaking up some of the old furnaces, beautiful crystals of artificial felspar were found. They occurred in small cavities in the lower part of the furnace, and some of the specimens had a beautiful amethystine tint. They have been found since at other places, but I believe they are excessively rare. Fortunately, I am able to place before you specimens of the artificial felspar obtained from the Sangerhausen furnaces. Here is one composed of crystals of considerable size—true crystals of felspar, which have been carefully examined by competent observers and analysed. We have four or five analyses, all of which are perfectly concordant, and agree with that of natural felspar. These specimens are very small, but at the same time the crystals are comparatively large.

We have, then, a proof of the formation of felspar by furnace operations, but I am not aware that any clue has been given to the precise *modus operandi*. Daubrée tells us that he has produced glassy felspar, or rhyacolite, by exposing obsidian to water at a high temperature; it was changed into a greyish matter, having still the same chemical characters, but by the naked eye it was seen to be crystalline, like a fine grained trachyte. The powder of the substance thus produced, when examined by the microscope, showed clearly the characters of crystallised felspar. He also obtained it by heating kaolin in a glass tube with the water of Plombières at a high temperature. If these statements are accurate we have proof of the formation of felspar by hydro-thermic action.

PHARMACEUTICAL MEETING.

Wednesday, February 3, 1864.

Mr. SANDFORD, *President, in the Chair.*

(*Continued from page 80.*)

Mr. SANGER read a paper "*On the Process of Percolation as Applied to Tinctures.*" After some general remarks on the process of percolation, the author referred to the directions for making tinctures given in the British Pharmacopœia. These, he said, looked like a compromise between the directions of the Edinburgh and London Colleges. The method now ordered was half maceration and half percolation. The directions for any tincture will serve for an illustration. We quote the first:—"Tinctura Aconiti. Take of aconite root, in fine powder, two ounces and a-half; rectified spirit, one pint. Macerate the aconite root for forty-eight hours, in fifteen ounces of the spirit, in a close vessel, agitating occasionally; then transfer to a percolator, and, when the fluid ceases to pass, pour into the percolator the remaining five ounces of the spirit. As soon as the percolation is completed, subject the contents of the percolator to pressure, filter the products, mix the liquids, and add sufficient rectified spirit to make up one pint." This process the author considered a good one. For details on the subject of percolation he referred the meeting to his prize essay, and now only expressed his opinion that by this method tinctures were obtained of a brighter and more natural colour, and of a more uniform strength, than by macerations as ordinarily used by druggists. The tincture was prepared in a short time; there was no necessity for the continued agitation so often forgotten in the hurry of business, and there was no temptation to make use of some of the preparation before the prescribed period of maceration had expired. He then proceeded to describe a percolator of his invention, which was exhibited to the meeting. [It consisted of a funnel without a stem, supported within a jar to receive the fluid percolated; the whole shut in by a cover, which could be rendered air-tight.] In carrying out the process of percolation, the packing of the ingredients was the most important thing to attend to. They should at first be moistened with a little of the menstruum to lay the dust, and might, in many cases, be advantageously divided by well-washed silver sand, a layer of which should be placed at the top. Three degrees of tightness may be observed in the packing—ginger and bark, for example, should be tightly packed, rhubarb moderately tight, and hops but loosely packed, or only pressed down on the surface. To illustrate the advantage of the process of percolation, the author stated that he had prepared three specimens of Tinct. Card. Co. by maceration, all of which differed in colour, while all he had made by percolation were alike in shade.

In the course of the discussion, Professor Redwood said he had no doubt Mr. Sanger's percolator was a useful instrument; but, for general use, he thought that made by the York Glass Company preferable. He thought placing the funnel within the jar was a waste of room, and made the instrument inconveniently bulky.

A short conversation followed, in the course of which a member said that he had found nothing answer the purpose of a percolator so well as a cylindrical pipe; and another stated that he considered the process of percolation an excellent one for making tinctures; but he preferred to carry it out himself in his own way.

BRISTOL NATURALISTS' SOCIETY.

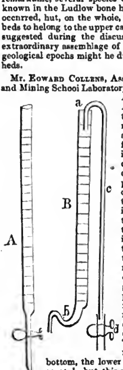
Thursday, February 4, 1864.

W. SANDERS, *F.G.S., President, in the Chair.*

THE purchase of an Apteryx, the rare, wingless bird of New Zealand, was sanctioned for presentation to the museum of the Bristol Institution.

Mr. **Charles Moore**, of Bath, detailed the results of his examination of some beds at Patchway, five miles from Bristol, laid open by the cuttings of the South Wales Union Railway. The Rhaetic beds, part of the English series corresponding to the Keuper sandstone of Germany, were recognised, and in close proximity to them a bed at first supposed to be white lias, but which, on examination, yielded Chonetes Hardrensis, and, what was more remarkable, several species of Chonodonts, hitherto only known in the Ludlow bone bed. Several Permian fossils occurred, but, on the whole, the author considered these beds to belong to the upper carboniferous limestone. It was suggested during the discussion of this paper, that this extraordinary assemblage of organic remains of different geological epochs might be due to the denudation of older beds.

Mr. **Edward Collens**, Assistant in the Bristol Trade and Mining School Laboratory, then read a paper "*On Some Improvements in Dr. Mohr's Burette.*" After adverting to the rapid increase in volumetric methods of analysis, and describing the ordinary form of Mohr's burette, A, in which the test solution came in contact with caoutchouc tubing, which, with permanganate of potash especially, was often injurious, the author stated that the idea had occurred to him that the pinch-cock might be made to regulate the ingress of air into the burette, instead of the egress of liquid, and he therefore contrived the arrangement sketched in B. At *a* is a tight-fitting cork, with glass tube, *c*, bent over parallel to the burette, terminating in a piece of India-rubber tubing and pinch-cock, *d*, which was thus brought close to its usual position. To avoid the entrance of minute air-bubbles at the bottom, the lower end of the burette was bent as at *b*, but this was not necessary for rough work. The delivery of the test liquid was quite as easily regulated as in the usual form, and it was not brought in contact with anything but glass. The junction at *a* might be advantageously made by fusion, in which case the instrument was filled by dipping the end, *b*, in the test liquid, and applying suction through the tube, *c*. The minor advantages of this modification were, immunity from dust and contact of air, thus preventing loss by evaporation, absorption of carbonic acid, &c.; and the author stated that, with a tight joint at *a*, the level of the liquid in the instrument had remained constant for many days.



A **Member** then exhibited a very large crystal of quartz, which gave rise to some discussion on its mode of formation, striæ, and other points of interest.

ACADEMY OF SCIENCES.

Monday, February 8, 1864.

The only chemical paper read at the last meeting of the Academy was "*On the Oxidation of Wine,*" by M. Berthelot. It contained nothing of general interest, being simply an account of experiments undertaken to refute M. Maumené and others.

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(TWELFTH NOTICE.)

(Continued from page 82.)

The notices of safflower and murexide lead directly to a consideration of the colours from aniline and its homologues, which have almost entirely supplanted them, and we may dismiss the former very briefly. Safflower, indeed, is now almost a subject for history, since it is at present only employed to dye silk of a peculiar cherry-red colour, which cannot yet be obtained from the aniline colours, but is in small demand.

Murexide deserves a more extended notice, from its interesting chemical history, but a very short account must suffice. This curious substance was first noticed by Prout, but was procured in a state of purity and analysed by Liebig and Wöhler. The author of this report, who was at the time a pupil in Liebig's laboratory, mentions, with becoming pride, the triumph he shared when a few grammes of murexide were first obtained in a state of purity.

Murexide, as all our readers know, is obtained from uric acid, which latter, for this purpose, is procured from Peruvian guano. The method by which uric acid is obtained from guano is very simple, and we are almost tempted to make a digression here on the subject of chemical patents—since a process for the purpose was patented by Mr. Brooman in 1856. It was, of course, a "communication," and it is not difficult to guess from whom. The process, as we have said, was of the simplest nature: it consisted in treating the guano with hydrochloric acid, which dissolves the carbonates, oxalates, and phosphates of ammonia, lime, and magnesia, and leaves the uric acid with some earthy and organic impurities. This residue can be employed in the manufacture of murexide, but pure uric acid can be obtained by dissolving it out with potash, and precipitating the solution with a mineral acid.

The transformation of uric acid into murexide is also effected in a very simple manner. Uric acid is first dissolved in cold nitric acid, to which it is added in small quantities at a time. In this way a dark brown liquid is obtained, which consists "chiefly of nitrate of urea, alloxan, and alloxantine. These two last substances frequently form a crystalline crust on the surface of the liquid, and their simultaneous presence forms one of the most favourable conditions for the abundant formation of murexide." To this dark brown liquid carbonate of ammonium is added, and the solution carefully evaporated at a low temperature. "It is better, however," says the reporter, "to add ammonia or its carbonate in small quantities at a time to the nitric solution, till the liquid is neutral or slightly alkaline, which reaction it should permanently maintain. This liquid is then heated to 60°—77° C, and yields, on cooling, crystals of murexide. The mother liquid is again heated with a small quantity of ammonia, and cooled, when a fresh crop of crystals of murexide are obtained."

We may quote here, as a fact for history, that Mr. Rumsey, of Manchester, once turned out 12 cwt. of murexide weekly, to produce which he consumed 12 tons of guano. But murexide now can be obtained from another source. The researches of Kopp and Hlaslwica have shown that, by the reaction of cyanide of potassium upon picric acid, a body is produced identical in every respect with the murexide obtained from uric acid. "To a hot saturated solution of the cyanide is added a solution of picric acid (one part dissolved in seven or eight parts of boiling water), and the solution is allowed to boil for some time. On cooling it deposits a crystalline mass, consisting chiefly of impure purpurate of potassium. By filtering and squeezing through linen, redissolving the crystalline mass in hot water, and adding carbonate of potash to the filtrate, the salt is reprecipitated; purpurate of potassium is thus obtained, this salt being but slightly soluble in the alkaline liquid. This precipitate is filtered off, pressed, and redissolved in hot water; sal ammoniac is then added, and, on cooling, beautiful crystals of murexide are obtained."

The methods of applying murexide to dyeing and printing are numerous and somewhat complicated. To dye purple, a mordant of corrosive sublimate is usually employed. The solution of murexide is added to a bath of sublimate, and the mixture is made acid with nitric acid. The silk is agitated in this bath (cold) until the desired shade is produced. Subsequent immersion in a bath of sublimate containing three per cent. of the salt gives freshness and brilliancy to the colour. To dye silk yellow, a salt of zinc is substituted for the salt of mercury, and the fabric is afterwards passed through water made slightly alkaline with carbonate of sodium. Wool is sometimes first mordanted with corrosive sublimate, and then passed through the murexide bath; or the process may be reversed. Sometimes nitrate of lead is added to the murexide bath, to facilitate the fixing of the colouring matter.

Rose colour and purple tints are obtained on cotton by nitrate of lead and murexide dissolved together in water. The cloth is first hung in a damp room pervaded by a slightly ammoniacal atmosphere, and then passed through a weak sublimate bath.

The murexide colours are very beautiful, and have the advantage of being permanent in light. The objection to them is, that they are excessively sensitive to the action of sulphurous acid, which tarnishes and discolours them with extreme rapidity. The air of all towns in which gas is burned is, therefore, inimical to them, and they have been almost entirely replaced by the aniline colours, to which we shall confine our next notice.

A System of Instruction in Qualitative Chemical Analysis. By Dr. C. Remigius Fresenius. Edited by J. Lloyd Bullock, F.C.S. Sixth Edition. 1864. London: J. Churchill and Sons.

It is a task of no inconsiderable pleasure to watch the steady growth and gradual improvement manifested in each succeeding edition of a standard work. The text-book before us is that which has had a large share—indeed, has taken the principal duty, in instructing the English student in chemical analysis. The system is that known to have been followed with great success in the Giessen laboratory and other schools of science in Germany and throughout the continent of Europe; and when a demand arose in this country some twenty years since for a text-book of chemical analysis, it was the English translation of Dr. Fresenius' work which first supplied the deficiency. A little later appeared the smaller treatise of Professor Will; but as the character of this work was indicated in the title, the "Outlines of Qualitative Analysis" could not be supposed to embrace the whole subject, and it omitted consequently many valuable details relating to the preparation of the chemical reagents, and their tests of purity, which were fully described by Fresenius. On comparing the present volume of 350 pages with former editions, it is at once manifest that the new system of spectrum analysis is that subject which has mainly contributed in augmenting the size of the treatise before us A noteworthy addition is the beautifully coloured frontispiece, indicative of the more characteristic spectra among the metallic elements. It is to be regretted that the position of the single green ray of thallium is not pointed out in the spectrum chart; but, as if in some measure to compensate for this omission, there is a remarkably well-written chapter descriptive of the leading chemical reactions of this element to be found at page 111. The detection of the rarer metals, *e.g.*, cæsium, rubidium, thorium, yttrium, cerium, lanthanium, didymium, and even erbium and terbium, are referred to under their respective analytical groups, and these particulars are printed in small type to denote their minor importance, or, rather, less frequent occurrence.

The metal "wolframium" and earth "berylla," are terms not commonly employed in the English language, but there is some foundation for their use in the fact that the symbols W and Be have always been taken as representing the metals tungsten and glucinum. We have not, however, yet gone so far as to adopt the German *kalium* and *natrium*.

Amongst the many novelties introduced into the present edition may be mentioned the use of the dialyser of Professor Graham; the full description and woodcut illustration of Kirchhoff and Bunsen's spectrum apparatus; the special instructions for the recognition of the vegeto-alkaloids; a systematic course to be adopted in the detection of poisons, including the search for unoxidised phosphorus; the several methods available for the isolation of strychnine, hydrocyanic acid, arsenic, &c., in the event of these substances being present in admixture with complex organic matters. In fact, as a treatise on Toxicology, Fresenius' Analysis can be strongly recommended; and in this connexion the numerous illustrations of apparatus employed in the detection of arsenic, phosphorus, and other poisons cannot fail to be highly suggestive to the analyst engaged in medico-legal inquiries.

The system of analysis adopted in the examination of soils, ashes of plants, and mineral waters remains substantially unaltered. There are several points in this direction which are, we think, yet open to considerable improvement. For instance, in the preparation of vegetable ashes for the purpose of identifying or determining the mineral constituents of the plant, it is not well to carry on the incineration until all the carbon is burnt off; but a more judicious course would be in all cases to rest satisfied with the complete charring of the organic structure, then to extract with water in order to remove the soluble alkaline salts, which are so readily volatilised if the incineration be pushed to the utmost limit, and then finally to dry and burn the carbonaceous residue for the purpose of recovering the remainder of the mineral salts. Another point open to criticism is the continued reference to "crenic and apocrenic acids" as constituents of natural waters. It is much to be regretted that the identification of dissolved organic matters and the determination of their amount by quantitative analysis are still notoriously unsatisfactory, and the day has yet to come when these heterogeneous matters shall be described and regarded in a clearer and more definite light.

The book before us is remarkably well printed, and free from errata. We have noticed but one or two trifling misprints; thus, at page 238, line 17, "on" should have been "no," and the type has slipped a little on page 246. The mode of division into chapters and paragraphs distinctly numbered facilitates reference; and there is much satisfaction in being informed of the authority upon which a statement is made, and the name has been generally given between parentheses. A very useful table of weights and measures concludes the volume. The kilogramme is here stated, we believe correctly, to be equal to 15,432 grains; whereas the English translation of "Liebig and Kopp's Annual Report" makes the same unit equal to 15,434 grains. There are some repetitions to be noticed in the analytical details prescribed for the examination of simple and of complex substances; but these are only such as could not be entirely avoided in a work devoted to the purposes of instruction. Altogether, we feel strongly disposed to recommend the work before us to the favourable notice of the student in chemical analysis; and must remark, in conclusion, that the sixth edition fully maintains the high character of a standard work which "Fresenius' Analysis" has so long enjoyed.

Researches on the Solar Spectra of the Chemical Elements. By G. Kirchhoff. Translated by H. E. Roscoe, B.A., Ph.D., F.R.S., &c. Part II. London: Macmillan and Co. 1864.

This second part of Kirchhoff's interesting and important work contains the latest observations of the author on the spectra of the metals potassium, rubidium, lithium, cesium, lanthanum, didymium, platinum, palladium, and an alloy of iridium and ruthenium. Beautifully executed diagrams are appended, in which the lines are laid down with the minutest accuracy. For instance, between the double line D, one nickel, one zine, and three antimony lines are seen to lie. Dr. Roscoe must be thanked for making this valuable continuation so soon accessible to English experimenters.

NOTICES OF PATENTS.

2835. *Improvements in Waterproofing, and in Recovering Products employed therein.* R. A. Brooman. Fleet Street, London. A communication. Dated October 21, 1862.

For the purposes of waterproofing, the inventor dissolves India-rubber, gutta-percha, resins, or metallic soaps, with or without sulphur, in bisulphide of carbon, ether, or other suitable and volatile solvent. Having placed one of these solutions in a vessel capable of being made air-tight, and immersed the fabrics or other articles to be waterproofed therein, the cover is adapted, and the goods withdrawn through an air-chamber into an adjoining receptacle; the communication being then closed, heat (by warm water) is applied to the second chamber; and whilst the solution is dried in the pores of the fabric, the solvent is recovered by distillation, and may be employed again repeatedly for similar purposes.

2852. *Solinometer.* W. S. Gamble. Islington. Dated October 23, 1862.

This name is applied to a kind of hydrometer fitted to and employed in connection with a steam-boiler for the purpose of indicating the density of its liquid contents. It carries within itself a small thermometer to show the degree of temperature, and the whole floats without a compound glass and metal cylinder, the graduations being read off from the front shortly after the admission of the water by a three-way cock.

Notices to Proceed.

2260. Charles Batteock, Wandsworth, Surrey, "Improvements in cigar lighters and fusee matches, part of said improvements being applicable also to vestas and matches, wax tapers, and candles."

2261. Warren Thompson, Rue Neuve des Martyres, Paris, "Improvements in electric telegraph apparatus."—Petitions recorded September 15, 1863.

3107. Thomas Vaughan Morgan, Battersea Works, Surrey, "Improvements in the treatment and purification of plumbago for the manufacture of crucibles and other fire-proof articles, and in apparatus employed therein."—Petition recorded December 9, 1863.

3232. James Shanks, St. Helen's, Lancashire, "Improvements in the manufacture of caustic soda and caustic potash."—Petition recorded December 22, 1863.

2283. Fedor de Wylde, Trinity Square, Tower Hill, London, "Improvements in the manufacture of an hydrated silica."—Petition recorded September 17, 1863.

2294. William Lorberg, Wyld's Rents, Bermondsey, Surrey, "Improvements in the treatment of rags, and obtaining valuable chemical products from the animal fibre therein."

2354. William George Helsby, Liverpool, "Improvements in mounting or setting transparent photographic pictures."

2359. Alfred Vincent Newton, Chancery Lane, London, "Improvements in the manufacture of gunpowder, and powder for blasting purposes."—A communication from Alfred Nobel, Rue St. Sebastien, Paris.—Petitions recorded September 24, 1863.

CORRESPONDENCE.

Cohesion Figures of Liquids.

To the Editor of the Chemical News.

Sir,—In a generally accurate report of my Lecture at the Pharmaceutical Society, contained in your last number, there are one or two corrections required. You make me say, p. 79, col. 1, "In general only one drop should be allowed to fall, as the effects are not always the same; but, in the case of a very volatile liquid like ether, the figure of which lasts but a second, several drops may be dropped in succession from a tube as the figures disappear."

Now, I never intended to convey the idea that "the effects are not always the same," when the observations are made with chemically clean surfaces. What I said was, that in the case of a fixed oil, one, and only one drop must be deposited on the surface of the water; that in the case of some volatile oils a second drop will sometimes displace the film left by the first drop, and form a second cohesion figure; and that in the case of ether, alcohol, wood-spirit, &c., many drops may be allowed to fall from a dropping-tube in regulated succession on the surface of the water. I see where your reporter misunderstood me. I remarked that each operator would have what the astronomers call *his personal equation*, so that one man's result might differ in neatness and precision from that of another.

Again, the beautiful phenomena that accompany the castor oil figure do not "last some hours," but only some seconds. The residual film without colour or border does last some hours.

Another trifling correction is required in the case of the cod-liver oil figure. I said, in answer to a question, that I had obtained a figure from the reputed pure oil, which I will call A; that a different figure was produced from a specimen which I purchased at a shop, B; that on mixing one-third of A with two-thirds of common fish oil, I obtained a figure nearly identical with that of B.

I am, &c. C. Tomlinson.

King's College, London, February 15.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

J. Howarth.—Marine glue.

W. A. W.—1. Yes. 2. Silk is the best insulator.

The answers to several correspondents are unavoidably postponed.

Book Received.—Dr. Herapath's "Address on Chemistry, &c.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Decomposition of Iodide of Mercury, by H. Rose.[*]

Iodide of mercury is very easily decomposed by cyanide of potassium. To estimate the mercury in the iodide the following process may be adopted. The cyanide of potassium is first rubbed in a mortar with twice its weight of quicklime. A little carbonate of magnesia is then placed in a tube closed at one end; the iodide mixed with eight or ten times its weight of the cyanide, and lime is next introduced; then a layer of the cyanide and lime is added; and lastly, a little carbonate of magnesia is placed on the top; the tube is now drawn out and bent, and the extremity is made to dip into a receiver containing water. Heat is now applied to the mixture, beginning at the top, and the mercury distils over.

Other mercuric compounds may be decomposed in the same manner.

According to Carius, iodide of mercury is completely decomposed by digestion with nitrate of silver in a not very acid solution. The reaction is definite enough to allow of its being utilised for an estimation. Iodide of silver, like iodide of mercury, is slightly soluble in nitrate of mercury.

The red iodide of mercury may be reduced by a solution of protochloride of tin, but the reduction is not complete. With an excess of hydrochloric acid the reduction is impossible, and the iodide becomes yellow when the mixture is heated. When, however, the mixture is supersaturated with potash, the reduction takes place. Iodide of potassium will also prevent the reduction with protochloride of tin, unless an excess of potash is present.

Metallic zinc completely decomposes iodide of mercury in the presence of water, forming iodide of zinc.

On Some Mineral Waters of Nova Scotia, by Professor How, *D.C.L., University of King's College, Windsor, N.S.*

Little has yet been done in the chemical examination of the mineral waters of Nova Scotia from the want of a systematic geological survey of the Province. They are, as appears from the following notices and analyses, of varied character, and there would be much scientific interest in an extended and thorough investigation into their qualities and composition. At the same time, if the results were duly published, the medicinal virtues which reside in some of the waters would be made generally known. It is probable, too, that new medicinal springs might be discovered. This is obviously a matter of sufficient importance to the Province, both in a sanitary and economic point of view, to demand the care and attention of an enlightened government. Mineral springs have been, and are still, so frequently the sole means of rendering localities famous and wealthy, by attracting residents for more or less lengthened seasons, that it is well worth while to possess any water of great curative value, and to make its merits known as extensively as possible. Nova Scotia appears to be able to add valuable medicinal waters to her mineral resources awaiting exploration and development. I propose in the following paper to give some facts about these mineral springs, and the results of my analyses.

Bras d'Or Saline Water, Cape Breton.—This water has an extraordinary and apparently well grounded reputation for procuring alleviations and effecting cures in various maladies, authentic cases being known of much benefit resulting from its use in rheumatism and severe headaches. A gentleman of high standing and of scientific reputation informed me that he had obtained a good appetite and increased strength by taking about five gallons of it, and by further use a moderation of the violence of asthmatic attacks to which he was subject; in fact, that its employment had proved a real blessing to him. A water possessing such qualities would, of course, be much resorted to; and it was considered worth while to erect a house for the accommodation of visitors soon after the merits of this spring became somewhat known.

There appear to be three springs at this locality, situated "near Kelly's, on the high road from Sydney to St. Peter's, in a brook that empties into the Salmon River, distant some two or three miles from the source of the river, six or seven from the southern shore of the Bras d'Or lake." On referring to the map accompanying Dr. Dawson's "Acadian Geology," at about the spot so indicated, Devonian and Silurian rocks are found to come in contact with syenite and other igneous rocks; and I have direct information that the water rises in syenitic rocks. The flow is said to be not more than a gallon in a minute. Whether all the springs become mingled in one stream I do not know. The analysis which follows was made[*] on a quantity of the water most esteemed, I apprehend, for medicinal virtues. The amount at my disposal did not enable me to make a thorough investigation, so that, no doubt, I do not give all its ingredients. The results were calculated for the English imperial gallon of 70,000 grains.

The water was clear, and of neutral reaction.

	Grains.
Iron and phosphoric acid . . .	traces.
Carbonates of lime and magnesia .	0·60
Sulphate of lime	0·94
Chloride of sodium	343·11
Chloride of potassium . . .	4·55
Chloride of calcium	308·90
Chloride of magnesium . . .	4·47
	662·57

Specific gravity at 54° = 1007·397.

The carbonates of lime and magnesia were thrown down by boiling. It was assumed that two-thirds of the precipitate thus obtained consisted of carbonate of lime, and the calculation made accordingly. The precipitate was so small that no great error could arise in this way. No iodine was detected in the saline residue from 1500 grains of the water.

The composition of this water is very remarkable, quantities of sulphates and carbonates so very small being rarely met with. The large amount of chloride of calcium is also very unusual. On looking over a large number of analyses of mineral waters, belonging to different parts of the world, I find none to resemble the present, excepting certain Canadian waters analysed and described by Hunt.[†] These form the first of the six classes in which he has arranged the mineral waters of Canada, and are characterised by "containing chloride of sodium, with large portions of chlorides of calcium and magnesium, sometimes with sulphates. The carbonates of lime and magnesia are either present only in very minute quantities, or are altogether wanting. These waters are generally very bitter to the taste, and always contain portions of bromides and iodides." It is also remarked, by the same authority,‡ that these brine springs are altogether unlike any hitherto studied; and particularly instanced are those of England, Germany, and the State of New York, in which the chloride of sodium greatly preponderates, and which are supposed to arise from the solution of rock salt. The brine springs of the Lower Silurian limestones (such as the Canadian waters in question), on the contrary, may be supposed, according to Hunt, to represent the composition of the ancient ocean in which these early strata were deposited. I have mentioned that the Bras d'Or water is said to arise in syenitic rocks. Crystalline limestones may exist at the locality. I have seen them in some parts of the rocks of Cape Breton coloured of the same tint in Dawson's map.

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[*] *Poggendorff's Annalen*, bd. cxviii, s. 165; *Bulletin de la Société Chimique*, January, 1864, p. 25.

[*] In the autumn of 1859.

[†] "Report on Geology of Canada," 1863, p. 531.

2. **Renfrew Brine Spring, Hants Co.**—This spring flows near the gold diggings of this place. I found it to yield about 1439 grains of solid matter to the imperial gallon, consisting principally of chloride of sodium, with but a small proportion of earthy salts.—[In 1862.]

3. **Brine Spring of River Philip, Cumberland Co.**—A spring exists here affording a dry salt of good taste and colour, some pounds of which were sent to the Exhibition at London in 1862. No information was furnished as to the spring; it arises, no doubt, in carboniferous rocks, in which formation salt springs are known to exist in several parts of this and other countries. Nothing, however, has yet been done in their examination, and the River Philip spring is the only one, so far as I know, that has been turned to any account.

4. **Wilmot Springs, Annapolis Co.**—These, situated about 100 miles from Halifax, afford a water which has been much resorted to. The Rev. Dr. Robertson, rector of the parish of Wilmot, has obligingly furnished me with the following information:—The water of the Wilmot springs is cold, with an abundant flow, and is highly charged with mineral substances, chiefly iron and copper (?) No correct analysis of it, I rather think, has yet been made. It is said to contain a small proportion of iodine. In former times the springs were much frequented, but of late years very few visitors have come to them. The water, however, is remarkably efficacious in curing cutaneous complaints or eruptions. In my own opinion, the Wilmot springs deserve to be better known and more frequented than they are at present. If the proprietors were men of substance and energy, I have not a doubt but that their locality would be one of the best known places in all Nova Scotia."

5. **Thermal (?) Spring near Chester, Lunenburg Co.**—Amos F. Morgan, Esq., has furnished me with the following details of a spring of clear water, issuing in the centre of a rising ground or small hillock in the woods in the neighbourhood of Chester. The temperature of the atmosphere at the time of finding the spring, in the beginning of March, was below the freezing point; but of the water, as far as could be judged, about that of new milk, the pool having no appearance of having been frozen over the whole winter. The basin filled with the water was considered to be about eight feet square. The mud at the bottom was covered with small holes about the size of a man's finger, and out of these rose continually bubbles of gas. The water tasted slightly bitter, or perhaps was imagined to taste so, but was peculiarly soft, so much so, that it felt more like oil than water in the mouth. It is possible that this water is decidedly thermal; and it would seem, from its described taste and oily character in the mouth, to be highly alkaline. The gas arising appears to be abundant. This water would be well worth investigation.

6. **Spa Spring Water, Windsor, Hants Co.**—This is a water rising in a field in a district in which gypsum is one of the prevailing rocks, the geological age being Lower Carboniferous.

The water has long been considered chalybeate, and has been taken medicinally by a number of persons, with what effect I do not know. It is well known as a favourite drink for horses and cattle. The chalybeate character of the water was inferred from its possessing a strong inky taste, and also from a certain red deposit found in the conduit pipes through which it ran, both of which were justly attributed to the presence of iron. There is, however, very little iron in the water as it issues from its outlet, as is seen in the following analysis made of the water carefully collected in a small reservoir, filled immediately from the spring rising beneath.

The water was perfectly colourless and clear; it had little taste, and that not inky; its temperature was 49° F., that of the air being 31° (so that it is slightly thermal; compare "Geol. Can.," p. 564.) It afforded the following constituents in an imperial gallon. (December, 1858):—

	Grains.
Carbonate of lime	17·50
Carbonate of iron	0·40
Carbonate of magnesia	0·31
Sulphate of lime	106·21
Sulphate of soda	0·68
Sulphate of potassa	0·38
Sulphate of magnesia	11·02
Chloride of sodium	0·90
Phosphoric acid and organic matter . .	traces
Silica	0·60
Grains in a gallon	138·00
Free carbonic acid (1·35 cubic inch at 33°) .	0·64
Specific gravity at 49° F.	1001·858

This water would be placed in the sixth class of Hunt,§ being rich in sulphates. The sulphate of lime (derived, no doubt, from the prevailing gypsum), which is the characteristic ingredient, is present in larger amount in only one out of fifteen waters from Cheltenham, in England, and is by no means a common constituent of waters in such large proportion. The water is known to possess purgative properties when taken freely, owing in part, no doubt, to the sulphate of magnesia present. The inky taste and the red deposit from the water are due to its action on the soil, and to its admixture with surface water, and are only observed when precautions are not taken to keep the spring-water pure. The chalybeate impregnation thus obtained is, of course, valuable, but will be subject to variation.

From the well-marked characters of the waters mentioned in this paper, it is evident that, in a systematic survey of the Province, the inquiry into its mineral springs would form a very interesting and useful part of the work involved in so desirable an undertaking.

On the Purification of Sulphuric Acid,
by F. Maxwell Lyte, *Esq.*

The result of several experiments in my laboratory, suggested by inquiries from correspondents of the Chemical News, as to the best means of obtaining sulphuric acid entirely free from arsenic, fully bear out the fact recorded by MM. Bussy and Buignet, viz., that arsenic, in order to pass during distillation, must be present in the state of arsenious acid. I have, however, been led to employ a different mode of purification, chiefly with a view to ensuring the complete absence of all nitrous products, and obtaining a pure acid from the very first, and of thereby obviating the necessity of changing the receiver,—a most dangerous operation when distilling sulphuric acid. If the acid contains nitrous compounds, I heat it in a porcelain capsule to a temperature of about 110° C., with a small portion of oxalic acid, till the latter is completely decomposed, and all effervescence has ceased; about ¼ to ½ per cent. is amply sufficient for nearly all samples of commercial acid. It is best to add the oxalic acid before heating, and to stir constantly till the reaction is completed. I now allow the acid to cool down to about 100° C., and add to it a solution of bichromate of potassa in sulphuric acid, or some of the salt itself in fine powder, until the pure green colour at first produced by the formation of sesquioxide of chromium is replaced by a yellowish green, indicating an admixture of chromic acid in the free state. The acid so prepared, being now distilled, passes from the first perfectly free from all impurity. The addition of the bichromate has another advantage, viz., that if it be first of all applied to a small sample of the commercial acid, it indicates the presence of free sulphurous acid, as well as of arsenious acid, and either of these being present, we may presume on the absence of nitrous compounds.

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‡ *Loc. cit.*, p. 564.

§ "Report on Geology of Canada," 1863.

No doubt permanganates would answer equally well; but the bichromate of potassa, which is cheap and easily procured, is so convenient and inexpensive as to leave nothing to be desired.

Bagneres de Bigorre, February 15.

PHARMACY, TOXICOLOGY, &c.

The British Pharmacopœia.

(Continued from page 87.)

Acidum Arseniosum.—The British Pharmacopœia follows that of the Dublin College in directing the arsenious acid of commerce to be resublimed for medicinal purposes. This is undoubtedly necessary if by the acid of commerce we are to understand the arsenic in powder commonly sold, which is often largely adulterated. The vitreous acid described by the London College in 1851, and which will always be supplied by wholesale houses, is, however, sufficiently pure, and another sublimation is quite unnecessary. Two tests are given for ascertaining the complete purity of arsenious acid, which can be applied by the pharmaceutist to the vitreous acid. The first is the complete volatilisation by heat. The second is a volumetric method by means of a normal solution of iodine. This method is based upon the fact that, when arsenious acid is brought into contact with iodine in the presence of water and an alkali, it is converted into arsenic acid. Four grains of arsenious acid are directed to be dissolved with eight grains of pure bicarbonate of soda. The quantity of alkali is not important so long as there is at least double the amount of arsenious acid present, such a proportion being necessary to combine with the hydriodic acid set free. The ultimate results of the reaction are expressed in the equation, $AsO_3 + 2I + 2NaO = AsO_5 + 2NaI$.

The volumetric solution of iodine is to be made by dissolving 111·125 grains of pure iodine and 150 grains of iodide of potassium in sufficient water to make a pint. 100 measures of this solution will contain one-tenth of an equivalent, or 12·7 grains of iodine; consequently, 80·8 measures will be necessary to oxidise four grains of arsenious acid. The iodine solution is directed to be added to the alkaline arsenical solution as long as the colour is discharged. A plainer indication of the termination of the reaction is, however, obtained by following the plan recommended in all books on volumetric analyses, where a little solution of starch is directed to be added to the arsenic solution. The smallest excess of iodine is then distinctly seen by the production of the well-known blue colour.

The same method is employed for determining the strength of the solution of *Acidum Sulphurosum.* The exact strength of this solution can hardly be a matter of much importance, but the Pharmacopœia intends a saturated solution of the acid in water, which will have the density 1·04. "One fluid drachm of this solution mixed with a little mucilage of starch does not acquire a permanent blue colour with the volumetric solution of iodine, until 164 measures of the latter have been added to it."

These directions are incomplete in one important but very obvious particular. It is omitted to be stated that the acid must be considerably diluted with water, or the analyst will probably be led into error. With dilute solutions of sulphurous acid the following reaction takes place:—$SO_2 + I + HO = So_3 + HI$; but Bunsen has shown that with a concentrated solution the reaction is in a short time reversed:—$SO_3 + HI = SO_2 + I + HO$. Strict accuracy, moreover, cannot be expected with a measured quantity. Fluid measures are seldom graduated with accuracy, and no two persons would probably measure exactly the same quantity. A fluid drachm besides requires 164 measures of the iodine solution, which involves filling the burette twice, or the employment of two. It would have been better to have directed a weighed quantity to be employed, although in that case a loss of acid would be experienced in consequence of the exposure. As we have said, however, the exact strength of this solution of sulphurous acid, so long as it is somewhere near the point of saturation, cannot be a matter of much importance.

The process given for tannic acid is one which may be easily applied to the production of the article on a small scale, but which no manufacturer would think of applying on a large. Its adoption by the Committee is somewhat surprising, since a good manufacturing process was offered to them by an experienced maker. The method more generally employed is the following:—Finely powdered gall-nut is made into a stiff paste with ether and water—one pound of galls require twenty ounces of ether and four ounces of water. This paste is placed in a canvas bag, and is then submitted to pressure. A thick solution of tannic acid is thus squeezed out, which only requires careful drying. To obtain the acid in the light vesicular condition in which it is found in commerce requires careful manipulation. It is best dried in small portions in a current of heated air, or the heat may be applied above the acid. A little gallic acid is no doubt obtained by the above process, but the amount is small, and can be of no importance.

The process for tartaric acid may be recommended to any pharmaceutist who cares to amuse himself by making a little of this acid, or who wishes to instruct an apprentice. A manufacture of the acid on a large scale would be more likely to employ the process we recently quoted from Dr. Hofmann's "Report on the International Exhibition." The inquiry again suggests itself—Why the compilers of the Pharmacopœia troubled themselves at all about these processes, well knowing that they would never be followed?

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture VI.—*Saturday, January* 9, 1864.

Ladies and Gentlemen,—I have one or two further remarks to add concerning the production of felspar. According to Dauhrée, when china clay, of which we shall speak by and by, is heated to a very high temperature in water containing silicate of soda, a double silicate of alumina and alkali is formed which has all the characters of felspar. Daubrée remarks that possibly the Sangenhausen felspar, of which I showed you some crystals on the last occasion, may have been produced by aqueous agency, although a furnace product. He seems to labour under a mistake in asserting that these crystals were obtained at the upper part of the furnace. The contrary is the fact. They were obtained below, in the hearth, at or near the bottom of the furnace. That, I think, is a very important point to bear in mind.

I also omitted to mention a singular product which may be obtained from our blast furnaces on a very large scale, and resembling pumice in character. If a small stream of common slag, of which you saw several specimens at the last lecture, be allowed to flow into water, it becomes puffed up into a light and remarkably porous body, very similar, indeed, in external character, to pumice, and suggesting, in fact, the mode in which pumice may have been formed. This white specimen was obtained in my presence in South Wales from a slag, which, allowed to consolidate in the ordinary way, is perfectly black, but which, owing to this fine state of division, is white. When breathed upon it emits an odour of sulphuretted hydrogen, owing to the presence of sulphide of calcium.

The next compound to which I have to direct your attention is mica. The formula of this body is

$$3RO,2SiO_3+2(Al_2O_3SiO_3).$$

The RO base is of the lime or potash type. You will remember that $3RO,2SiO_3$ is the formula expressive of wollastonite. The oxygen of the silica in mica is equal to that of the alumina series. Mitscherlich found magnesian mica in an old slag heap in Sweden; and Hausmann is also said to have found mica in cavities of sandstone from the hearth of a blast furnace, which previously showed no trace of mica. I have examined several specimens from such hearths, but I have never found any trace of mica in them. Daubrée informs us that he produced uniaxial mica in hexagonal scales from clay in superheated water, containing silicates dissolved. These are all the facts which we know at present concerning the artificial production of mica.

I will direct your attention for a few moments to another silicate of great interest, especially in an economical point of view. I allude to ultramarine, which is a compound of silicate of soda and alumina. This remarkable body, which has such a fine colour, may be artificially produced, and is now prepared, in fact, on a very large scale as a chemical product. Chemically, it is identical with the native mineral, though certainly, in other respects, it is inferior to it. The quality of the tint, I think, and also certain other physical points connected with it, distinguish it from native ultramarine. It was accidentally found in a soda furnace a great many years ago by Guimet.

It is made by heating carbonate of soda and China clay with an excess of sulphur, under certain conditions as to temperature. It may be made with great facility in covered crucibles, by keeping them heated for about three or four hours at a tolerably red heat. You obtain thus a greenish product. Here is some of it; but it becomes blue on roasting with access of air. There is considerable difficulty in producing the right quality of tint, as there is with almost all colours. I have made a great many experiments upon this subject, occupying several months. Here are several of the products obtained directly in the manner described. The colouring principle is still very mysterious. Sulphide of iron is, no doubt, in some way or other connected with it. What the precise chemical principle is, we are not able to assert at present with any degree of certainty. The colour depends evidently upon the presence of a small quantity of sulphide of iron, which is one of the constituents. It is immediately discharged on the application of an acid, sulphuretted hydrogen being evolved, and the whole mass being rendered colourless. In the native *lapis lazuli*, or ultramarine, you will almost always observe the association of iron pyrites.

The hydrated silicates, which we have next to consider, occur abundantly in nature, and constitute some of the most beautiful minerals which adorn our mineralogical collections, as, for example, the extensive family of zeolites. They occur especially in the cavities of rocks of igneous origin, as well as in sedimentary beds—stilbite and apophyllite, for instance, in the fresh water limestones of Auvergne. Hydrated silicates are also met with in fossiliferous limestones in Scotland. These silicates lose their water when exposed to a good red heat; yet Bunsen has shown, by experiment, that it is possible to produce a silicate at a bright red heat which contains water. He took two parts by weight of lime and ten of silica, and mixed them intimately together. He then put them into ninety parts by weight of molten caustic potash, keeping the whole at a bright red heat for some time, and allowed the mixture to cool slowly. In this way a white product is obtained, which, when put into water, forms beautiful white crystals of a silicate of lime containing water, the excess of potash dissolving out. We have repeated this experiment, using for the purpose a gold crucible, which is now a common vessel in our laboratories. Here is the result. This is most distinctly crystallised, though it has lost a little of its water. It has the formula to which I have had occasion to refer so frequently—namely, that of wollastonite *plus* a small quantity of water, the amount of which is not distinctly stated. The formula is,—$3CaO,2SiO_3+Aq$, the oxygen of the silica being double that of the lime. Possibly the crystals may have been hydrated by the action of the water. This silicate loses all its water at a red heat, after the potash in which it was formed is dissolved out. I should observe, that molten caustic potash may retain water, even at high temperatures. In fact, the water cannot be expelled by heat alone. It might be urged, that the silicate of lime produced is at first anhydrous, and subsequently, as I have said, becomes hydrated by the action of the water. Some hydrated silicates are decomposed with more or less rapidity by exposure to the air. The well-known mineral, laumonite, undergoes decomposition on exposure to the air, and becomes opaque and pulverulent in mineralogical cabinets. Many hydrated silicates, on the other hand, are not thus decomposed. The composition of laumonite is $3CaO,2SiO_3$ *plus* three equivalents of silicate of alumina of the formula $Al_2O_3,2SiO_3$, and twelve equivalents of water. But even anhydrous, as well as hydrated, silicates undergo slow decomposition by exposure to the air. Take the familiar case of common glass. It is no uncommon thing to obtain specimens of glass from old buildings, which present most singular results in respect to corrosion. I have specimens which present numerous small spherical cavities more or less regularly diffused over the whole surface. The anhydrous silicates which are especially subject to the decomposing influence of the atmosphere are those which contain much alkaline base. Felspar is thus decomposed, forming kaolin—an amorphous hydrated silicate of alumina, the potash being washed away as silicate, or as silicate and carbonate, with the separation of more or less silica. At high temperatures water exerts a strongly decomposing action, even upon silicates like glass. I have already referred to some of the results of this action. We shall have further to consider it by-and-by.

In nature there is strong evidence for supposing that all hydrated silicates result from the action of water percolating through rocks. In many volcanic rocks—rocks clearly of igneous origin—cavities abound, containing, as I have said, beautiful crystals of hydrated silicates. Well-known specimens of such crystals abound in all our mineralogical cabinets.

With regard to the formation of these hydrated silicates, I have first to call your attention to some extremely interesting, and, as it appears to me, important observations by Daubrée, who has given us the results of experiments which have now lasted for at least two thousand years, and his remarks are in every way remarkable and deserving of attention. At Plombières are the remains of Roman works, constructed with a view to carry off the thermal waters there, the highest temperature of which is from 70° to 73° centigrade. Under the pavement of the streets, also, at a great depth, are subterranean conduits or aqueducts, of which the object was to intercept the thermal waters, and convey them to reservoirs. Where the waters emerged, the Romans made a bed of concrete, but without sand, using lime, fragments of brick, and sandstone (*grès bizarré*.) This bed of concrete extends more than ninety metres in length, and in some places to the depth of not less than three metres. It rests occasionally directly upon the granite of that region, but for the most part is separated from it by a bed of alluvial gravel. By the long-continued action of the thermal waters, singular chemical changes have taken place, and zeolites, together with other minerals, have been produced. They occur especially in cavities in the mass, in which they form mamillated and sometimes crystalline incrustations. In the granite, subject to precisely the same conditions as the brick and mortar, no zeolites were detected. There are in the museum specimens from this place.

Daubrée has detected several compounds in this concrete. The first to which I shall call your attention is the well-known mineral apophyllite—undoubtedly one of the most beautiful minerals in the world. It crystallises in the pyramidal system. It has the same formula as wollastonite, namely, three equivalents of base of the RO, or lime type, two equivalents of silica, and two of water; but the base consists of potash and lime, and the relation of the potash to the lime is as one to eight—eight equivalents of lime to one of potash — $3RO,2SiO_3+2HO$. Fluor is mentioned in small proportion in many analyses. Daubrés found the apophyllite lining small cavities in the calcareous part of the concrete. It has precisely the same crystalline form as the native mineral. In fact, it is in all respects identical with it. The thermal waters at Plombières contain an alkaline silicate, and by the action of this water flowing over the carbonate of lime during these twenty centuries, apophyllite has been formed. We have the carbonate of lime in the concrete, the silicate of potash in the water, and all the elements requisite to constitute apophyllite; and, accordingly, we have it produced. The proportion of the silicate of potash in the water may be very small, but the water has been perpetually renewed. The stream has continued to flow over the concrete, and in time the mineral has been formed on a somewhat considerable scale.

Native apophyllite occurs precisely in similar conditions. It is met with in cavities, and in veins, in transition slate, in amygdaloidal rocks, and in basalt; in fact, precisely in such conditions in which water may have operated by percolation, as it has done in the production of the artificial mineral at Plombières.

Another mineral which Daubrée has found produced in these curious remains of Roman workmanship is the well-known substance called chabasie. It is rhombohedral, approximating to the cube in point of form. The first part of its formula is the same as in apophyllite—a silicate of the RO base. Then there are three equivalents of a silicate of alumina, *plus* 18 of water—

$$3RO,2SiO_3+3(Al_2O_3,2SiO_3)+18HO.$$

Now, this base (RO) is represented by lime, soda, and potash, $RO = CaO,NaO,KO$. In many of the cavities in the bricks were perfectly colourless and limpid crystals of chabasie, exactly similar to the native mineral in all respects. They presented slight striations parallel to the edges like many of the native crystals, and also the usual macle in some cases. The crystals were measured, and found to present exactly the same characters as native specimens.

Daubrée tells us that he detected other zeolitic minerals, but has not yet proved their identity with native species, not having been able to obtain them sufficiently pure and in sufficient quantity for analysis. In several cases he has observed the chabasie crystals studded over with microscopic crystals, similar in all respects to a mineral termed gismondine; and, more rarely, needle-like scolezite occurs, and also a few prisms like harmatome. The thickness of these zeolitic incrustations is not more than about $\frac{4}{100}$ths of an inch; so that, after all, the crystals are but microscopic, but still they are identically the same in character as those occurring in nature. The size is a question of time. If we can get crystals of this size in 2000 years, we can, of course, get them proportionately larger in 100,000 years; and even 100,000 years is a short period in a geological point of view.

In cavities at the lower part of the bed of masonry, and near the points which receive a direct jet of thermal water, occur tolerably copious, gelatinous, transparent, and colourless deposits, the substance of which becomes, on drying in the air, opaque, snow-white, and mamillated, presenting the appearance of concentric layers, which are fibrous in fracture, and highly suggestive of the structure of malachite, or certain kinds of brown hæmatite, with which every geologist is familiar. This substance gelatinises with acids. It has a simple formula—one equivalent of lime, one of silica, and two of water, so that the oxygen of the silica is three times that of the lime:—

$$CaO,SiO_3 + 2HO.$$

Along with the minerals which I have just mentioned, Daubrée has found hyalite, which we studied in a previous lecture. It could not be distinguished from that found in basalts. He also discovered a variety of common opal, or a substance exactly resembling opal in all respects, having a greyish colour, and resinous lustre. He found arragonite and calcspar associated with chabasie, as in the volcanic rocks of Iceland. There was also fluorspar, white, and occasionally of a violet tint, occurring often in the vicinity of apophyllite, which itself frequently contains fluor. There is no difficulty in accounting for the presence of this fluorspar, for the water of Plombières was found to contain fluor. I spoke to you, on a former occasion, of the solubility of fluor spar in water. He also met with what he believed to be a new species of salt,—a hydrated carbonate of magnesia, though that fact is not ascertained at present, the quantity obtained being too small for analysis.

Here, then, we have a number of minerals produced, apparently, in the same conditions. These zeolites do not occur exceptionally, but in every part of the concrete traversed by the thermal waters. I think you will agree with me, that not only the identity of these zeolites, in their physical and chemical characters, with those occurring in nature, but also the apparent identity of the conditions under which both have been formed, is exceedingly interesting and instructive to the geologist. These conditions are of the most ordinary kind. There is no necessity whatever for the assumption of the agency of water at very high temperatures, and, consequently, under very great pressure, although, in some cases, there can be little doubt that these conditions have obtained. Wöhler dissolved and crystallised apophyllite in water at 180° centigrade, under a pressure of ten atmospheres. But we see that, under ordinary conditions, some of our most beautiful minerals have been generated simply by the action of a mineral spring operating, century after century, upon a common bed of concrete. Daubrée observes that, notwithstanding the extreme hardness of the Roman masonry, it was yet pervious to the thermal waters by cavities, by fissures, by the substance of the mortar itself being porous, and especially by the innumerable blisters produced in the bricks by burning. It is curious that such distinct minerals should be formed close to each other in conditions apparently so similar,—from the same matter under the action of the same thermal water. Daubrée remarks:—"If it were not for the difference of colour, it would even be very possible to confound parts of the concrete charged with zeolites with basaltic tufas, in which the same minerals have been formed. The bricks, with their '*boursoufflures*' and their drusy cavities, imitate, in a surprising manner, amygdaloidal rocks. Such an identity in results incontestably reveals great analogies in origin."

We now come to the transformation of glass into zeolitic substances by means of superheated water. I spoke to you on a former occasion of the action of water at a high temperature—400° centigrade—and, therefore, under great pressure, upon glass. Daubrée finds, that when the temperature is lower, the products are different. He obtained a hydrated silicate, which retained some of the alkali, by the action of water at 200° centigrade. The form of the glass was preserved, but the glass itself increased in volume about one-third, and became opaque and snow-white. It is found to be very decidedly fibrous in structure. It is easily fusible, and completely decomposable by the action of acids—hydrochloric acid, for example—even without the aid of heat. Its composition, after washing well with boiling water, and then drying at 100° centigrade, was very analogous to the mineral called pectolite, which occurs in spherical masses, consisting of delicate radiated fibres. It contained—

Silica	61·8	per cent.
Lime	21·9	„
Magnesia . . .	3·9	„
Soda	6·3	„
Water	4·2	„
	98·1	

and traces of alumina. By the action of water at 400° centigrade, Daubrée, it may be remembered, obtained a multitude of minute crystals of quartz, and also wollastonite in acicular crystals. This, again, is important, as showing that different products may be obtained from the same silicate of soda and lime by the operation of water at different temperatures.

The hydrated silicate, to which I have next to direct your attention, is one which abounds in nature—namely, clay. I intend to speak of clay only chemically. It is essentially a hydrated silicate of alumina—a silicate of alumina combined with water. The water cannot be expelled at a very gentle temperature—for example, by boiling. By exposing it to a boiling temperature, you may drive off what is called the hygroscopic portion of the water—that which forms no part of the essential constitution of the clay, but the water of combination is expelled at a higher temperature. Upon this water of combination depends the plastic property of the clay, and when it is driven off, the fictile property of the clay—or its power of being moulded—is lost. When the water of combination has been once removed by a high temperature, the clay cannot regain it by the addition of water.

Apparently great varieties of clay occur in nature, but they are all reducible to one or two simple formulæ. The various kinds of this hydrated silicate are due chiefly to the admixture of foreign matters. I shall take, as a typical example of all clay, kaolin, or China clay, which occurs in Cornwall, and I shall show you how it may be derived from felspatic rocks. There are many analyses of this clay which are very nearly concordant. I will give you one of the most reliable of China clay from Cornwall:—

Silica	46·32
Alumina	39·74
Water (combined) . . .	12·67

Those are the essential ingredients. The accidental ingredients which are more or less frequently found in this clay in small quantity, but which are unessential, are—

Lime	0·36
Magnesia	0·44
Oxide of iron	0·27

This is one of the published analyses. I have not the slightest doubt that there is an omission here, for in all the clays which we have examined a sensible amount of alkali is present; but unfortunately the determination of alkali involves a great deal of trouble, and chemists will not incur it unless they have reason for doing so, and wish, for some scientific purpose, to work out the analysis properly.

Such, then, is the composition of China clay, which is so extensively used by the potters. Let us see how this China clay may be derived from felspar. We know that it may be so derived, because we can distinctly trace the progress of its formation in Cornwall and elsewhere. We will take, first of all, the formula of felspar, which consists, you will remember, of a silicate of potash combined with a silicate of alumina. We require two equivalents of felspar, and, to make the formula quite plain, I will express it in this way—$2KO + 2Al_2O_3 + 8SiO_3$. You will find that that represents exactly two equivalents of felspar. If we then deduct from those two equivalents of felspar two of potash and five of silica, we get the formula of kaolin, or one of the formulæ most generally adopted as expressive of the composition of kaolin—$2Al_2O_3 + 3SiO_3$. The formula is not thoroughly settled by chemists, but the one I have given is not far from the truth. Thus, two equivalents of potash and five of silica have to be removed from the felspar. The silica may go off partly as silicate of potash, and possibly partly in a free state. There is, then, no chemical difficulty whatever in understanding how kaolin should be derived from felspar, and there is no doubt whatever that kaolin and all other clays have proceeded from some rocks of this kind.

I will make some special observations on a few important clays which abound in this country, especially in our coal measures, and which possess highly refractory properties, or, in other words, resist high temperatures. These are termed fire clays. They consist essentially of hydrated silicate of alumina. We have examined many of them, and in all we find a considerable amount of silica in the form of sand. I will give you the composition of one of the most refractory of these clays, which is extensively used by glass makers in making their pots. It is a Stourbridge clay of best quality:—

Silica	65·10
Alumina	22·22
Potash	0·18
Lime	0·14
Magnesia	0·18
Oxide of iron	1·92
Phosphoric acid	0·06
Organic matter	0·58
Water (combined) . . .	7·10
Water (hygroscopic) . . .	2·18
	99·66

The silica exists partly—in fact, the largest part—combined with alumina, and partly in the form of grains of sand. The sand may be separated more or less completely by the process of levigation, that is, by triturating the clay, and then suspending it in water. The particles of clay being finest, will remain longest suspended, and the particles of sand will go to the bottom. Potash is present in the clay to a small extent, and possibly a little soda too. I venture to affirm that in every clay, without one exception, if due search be made, potash will be found—frequently in company with soda. In some fire-clays it is found to the amount of 2 per cent. Soda has been detected to the extent of 3 per cent. Magnesia also is always, or almost always, present. Frequently these clays contain iron pyrites diffused through the mass, and this is a source of great inconvenience to brick-makers. The pyrites becomes oxidised in the burning, and acts injuriously upon the clay, covering the bricks with small black spots. Phosphoric acid is present, as we might expect. In analyses of clay for commercial purposes several of these ingredients are omitted, such as the phosphoric acid and the alkali. In the analysis given the organic matter amounts to only about one half per cent., and consists, probably, of bituminous, or coaly matter. The water combined with the clay is that which cannot be displaced at a temperature, say, of 100° centigrade, or even much higher. The hygroscopic water is that which can be displaced by dessication at a comparatively low temperature. These clays are very often dark in colour, and unctuous to the touch. Whatever varieties clays may present in external characters, they are, in a chemical sense, extremely similar. I have endeavoured to explain how clays may be derived by the conjoined action of water and carbonic acid upon rocks—such as felspar—during long periods of time.

I have placed before you a number of illustrations of hydrated silicates—silicates produced by double decomposition—the decomposition of silicate of soda by various metallic salts. We have here, for example, a pale blue silicate of copper so produced. This is a true and certain combination of silica and oxide of copper. We find on boiling it that there is no change of colour, as would be the case if there were no combination with silica, and the blue colour were due to hydrated oxide of copper. Then we have a silicate of cobalt and a silicate of iron produced in the same way. In the formation of this silicate of copper, a double decomposition has taken place. The silica of the silicate of soda has left the soda, and gone to the copper, and the acid of the salt of copper has left the copper, and gone to the soda. Here is a specimen of silicate of lead. It is perfectly hard, and gelatinous, like a very strong soap.

We will now proceed with another branch of our subject, and one of great interest—namely, sulphur and the sulphides.

Sulphur appears to have played a very important part in the economy of this earth. We find it occurring native; we find it in combination with metals, forming various sulphides; and we find it as sulphuric acid in combination with lime, forming gypsum, and with other bases. It occurs also in mineral waters as sulphuretted hydrogen; and it is evolved from volcanoes in the form of sulphurous acid, as well as in the form of sulphuretted hydrogen. With its properties generally, I must take it for granted that you are familiar. We all know it in the form of common brimstone, which, when heated sufficiently, takes fire upon access of air, and continues to burn, producing sulphurous acid. Sulphur has a very powerful affinity for many metals. This is the case with respect to iron, lead, and copper. Some sulphides may be exposed to any degree of heat without access of air, and yet remain permanent, undergoing no trace whatever of decomposition. This is the case, for example, with sulphide of lead, and certain sulphides of iron. There are sulphides which are partially decomposed by heat alone. For instance, iron pyrites, when strongly heated in a close vessel, loses about half its sulphur. There are others, again, which are wholly decomposed, when heated, without access of air, as sulphide of gold; but this sulphide has never been found in nature.

Metallic sulphides differ very much—especially in external character—according to their mode of preparation. We have them in the amorphous state, and we have them well crystallised. By precipitation from solution, they are generally—or, at all events, in the laboratory of the chemist—thrown down in the amorphous state. Here is a specimen of a nearly white powder, which is a compound of sulphur and zinc, rapidly produced by precipitation from solution. Here is one of the same sulphide which has a crystalline structure, and is entirely different in outward appearance from that rapidly produced. Here, again, are two sulphides of antimony. They are identical in chemical composition, and yet the two are extremely dissimilar in their external characters. One has been produced by precipitation, and the other is the same sulphide fused after precipitation. The one is an orange-red powder, quite amorphous; and the other, which is the same substance after fusion, presents the appearance of a metallic body, possessing a highly metallic lustre and crystalline structure. So, again, with sulphide of bismuth. This specimen is amorphous, thrown down from solution; and here is another specimen of the sulphide, which, after fusion, has become lustrous and highly crystalline.

The decomposition of some of these sulphides under certain conditions may be interesting to the geologist. There is one especially to which I will call your attention for a moment, namely, the sulphide of silver. It occurs abundantly in nature. If we take that compound, heat it, say to redness, and then expose it to the action of the vapour of water, or to a current of hydrogen, it is decomposed, the sulphur passing off, and metallic silver being left. The silver so left presents exactly the same form as those beautiful specimens of capillary native silver which occur in our mineralogical cabinets. Some of the sulphides which we find in nature undergo spontaneous decomposition. This is the case, for instance, with one of the sulphides of iron—white iron pyrites, a particular species of bisulphide. It decomposes, takes oxygen from the air, and forms the well known yellow mineral substance called *misy*. We have numerous examples of this in the museum. It is derived by the weathering of iron pyrites. It is a yellow substance, and is a basic sulphate of peroxide of iron. Again, we find iron pyrites, converted superficially into brown oxide of iron, but the elimination of the sulphuric acid generated may be owing to the action of bicarbonate of lime.

I shall first speak of iron pyrites. Although I have set apart a lecture expressly for iron, I must forestall that part of the subject in so far as relates to iron pyrites—a compound of the highest interest. It consists of one equivalent of iron and two of sulphur. There are two well-known, distinct mineralogical species, of which the composition per cent. is the same, but the crystalline forms are very different. The cubical variety is the one commonly met with; and it is that which is most persistent when exposed to the air.

I wish to draw your attention particularly to the conditions under which iron pyrites may be formed. There are some curious points relating to its occurrence in nature which depend upon these conditions. Iron pyrites may be formed directly by the dry way. There are several processes given in chemical books with which I need not trouble you. I wish to fix your attention especially on the proof of its formation in nature in the wet way—that is, by the agency of liquids. In the first place, we find it associated with minerals which are evidently of aqueous origin, and associated in such a manner that it is impossible that the iron pyrites could have been formed in any other way than by the agency of liquids. We find it not unfrequently occurring in clay iron ores, and in little cracks in the centre, even, of balls of ironstone. We find it constantly in coal. I have never yet examined a single specimen of coal which did not contain iron pyrites, the pyrites being sometimes interstratified with coal in little beds, sometimes existing in nodular masses, sometimes in exceedingly thin films, sometimes diffused in minute particles through the mass, and sometimes existing in a state of division so fine as to be imperceptible to the eye, but always capable of being detected by chemical analysis. Here is a specimen of cubical pyrites in the centre of a little ball of ironstone, which must have been produced entirely by aqueous action. Not only is there iron pyrites here, but also zincblende—sulphide of zinc; and it is impossible that that iron pyrites could have been produced there except by the agency of liquids. There is a well-known experiment recorded by Bischoff, and often repeated, of the artificial production of iron pyrites in a bottle containing the remains of an unfortunate mouse, which had been left for some years in a solution of green copperas. Distinct cubes of iron pyrites—very small it is true—are said to have been so produced. I hoped to have been able to present to you a repetition of this experiment. For some years I kept the remains of a rat in a solution of green copperas, but unfortunately the air got access. I did not find the slightest trace of iron pyrites, but, as I said, the experiment was defective, and therefore I attach no importance to it.

I will place before you a specimen of iron pyrites produced in the dry way. It is in minute cubes or octahedrons, and was prepared by heating a mixture of sesquioxide of iron, sulphur, and sal-ammoniac, at a temperature slightly exceeding that at which sal-ammoniac sublimes. For that process we are indebted to Wöhler. Some of the most beautiful specimens of crystals of iron pyrites I have ever seen are in the possession of Mr. Fox, of Falmouth. These crystals were first observed by Mr. Lowe, of the Chartered Gas Works. You will find his name in published works, but it has been spelt in the German fashion, with two dots over the o [ö]. The iron pyrites was produced by subliming, at a long-continued and dull red-heat, rough sal-ammoniac, containing sulphate of alumina, in vessels coated internally with clay. The crystals were found in connection with chloride of iron.

We have unmistakable evidence—first, that iron pyrites may be easily made in the dry way at moderate temperatures; and, secondly, that it may be produced by the wet way. In fact, it must have been produced by the wet way in many conditions in which we find it in nature. I may here direct attention to what Bunsen says on this subject in his admirable paper on the pseudo-volcanic phenomena of Iceland. I doubt whether the merit of this paper has been fully recognised by the geologists of this country. It is well known to chemists, that sulphide of iron, under certain conditions—for example, in the presence of an alkaline sulphide containing an excess of sulphur—appears, to a slight extent, soluble when in a fine state of division. It makes a green solution, which, on standing, deposits flocks of sulphide of iron. A condition like this appears to obtain in Iceland; and Bunsen suggests, and very properly, that it is exceedingly probable that iron pyrites may have been so produced. There is one curious point connected with this subject—namely, the connexion of gold with the pyrites. The association is pretty general. It is still a question whether the gold is wholly there in the form of metallic gold, or whether some of it may not exist as sulphide of gold in combination or association with the sulphide of iron. The gold is undoubtedly present as metallic gold to a considerable extent in most cases; but, from what I know, I am rather inclined to believe that its existence as sulphide of gold is probable to a certain extent.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following paper will be read:—"On the Non-Metallic Impurities of Refined Copper," by Prof. Abel.

CHEMICAL SOCIETY.

Thursday, February 18, 1864.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

The minutes of the previous meeting having been read and confirmed, and the several donations to the library announced and acknowledged, the Society proceeded to ballot for the election of the following gentlemen, all of whom were duly received, as Fellows, into the Society, viz.:—Anselim Odling, Benjamin E. R. Newlands, James Dearden, Henry Bassett, Alfred Henry Allen, William Sydney Gibbons, Esqrs., Dr. Campbell Morfit, and Thomas Stevenson, M.B.

The Secretary read a paper, by Mr. C. Greville Williams, "*On Acetanilide.*" After referring to the processes of Gerhardt and others, by means of which this body has hitherto been prepared, the author described a new mode of formation, in which aniline and acetic acid were simply cohobated in the presence of water; after boiling some time, the new product commences to sublime, and, by then charging the receiver, it may be collected in the form of white crystals. Its formula—C_8H_9NO—shows that one atom of water is liberated during the reaction, which may be thus expressed:—

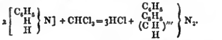
$$C_6H_7N + C_2H_4O_2 = C_8H_9NO + H_2O.$$

Acetanilide is a white, wax-like solid, which, when fused, has the specific gravity 1·099. It is soluble in ether, alcohol, and oils; from lemon oil it crystallises in beautiful needles. It boils at 195 degrees centigrade, and the vapour density, determined according to the method of M. St. Claire Deville, was found to be 4·847, whilst the number demanded by theory is 4·671. This result would have shown a closer agreement but for the separation of a small quantity of brown matter, which was left as a residue in the balloon. By the action of sodium, this amide yields aniline and an oily body not yet fully examined.

The President remarked upon the interest attaching to the author's communication, in consequence of the announcement of a somewhat unusual phenomenon, viz., the separation of water from the elements composing a salt by the action of heat upon its aqueous solution.

Dr. Odling stated that he received from Mr. Sydney Hall, of Swansea, a specimen of a white body which sublimes during the manufacture of aniline. Mr. Nicholson also had shown him the same substance. There is no doubt that these were acetanilide; and, in attempting to produce this same substance from the acetate of aniline, he found, contrary to the recommendation of Mr. C. Greville Williams, that the presence of an excess of *base* facilitated its formation. In fact, the substance in question was best prepared by the action of heat upon the acetate of aniline in a bath of aniline. In a similar manner he had already succeeded in producing benzanilide and hippuranilide by the action of heat upon the salts corresponding.

Dr. A. W. Hofmann stated that acetanilide had of late become for him the starting-point of a new series of researches. Some years ago he had been engaged in experiments on the action of chloroform upon aniline. When this base was digested with chloroform, it was found that the whole of the chlorine united with a corresponding amount of hydrogen, forming hydrochloric acid, whilst a new body was produced, which might be called diphenyl-formyl-diamine, thus:—



$$2\left[\left.\begin{matrix}C_6H_5\\H\\H\end{matrix}\right\}N\right] + CHCl_3 = 3HCl + \left.\begin{matrix}C_6H_5\\C_6H_5\\(C\,\underset{H}{H})'''\end{matrix}\right\}N_2.$$

A compound of this kind was known among the derivatives of ammonia. In fact, cyanide of ammonium to formyl-diamine is produced by the action of ammonia upon chloroform, and corresponds to the above aniline compound. Its formula may be thus written:—

$$\left.\begin{matrix}(CH)'''\\ H\\ H\\ H\end{matrix}\right\} N_2.$$

At this stage, the investigation was allowed to repose for a time; and it was only lately that some experiments with acetanilide, in which he had been aided by Mr. Tingle, had led him back to the former direction. He would remind the Society of the reactions by which, in contact with phosphoric acid or other dehydrating agent, acetate of ammonium loses one and two atoms of water respectively, becoming thereby transformed into acetamide and acetonitrile—

$$\text{I. } NH_3,C_2H_4O_2 = C_2H_5NO + H_2O.$$
$$\text{II. } NH_3,C_2H_4O_2 = C_2H_3N + 2H_2O.$$

By distilling the acetate of aniline with phosphoric acid, the phenyl compound corresponding to acetamide was easily obtained; but by pushing the action of dehydrating agents further, so as to realise the second stage of the process, the results became complicated, and generally a charred mass only was the result. The case was different, however, when a hydrogenated body was present at the same time. Amongst other agents, the speaker had examined the action of pentachloride of phosphorus upon a mixture of aniline and acetanilide. Under these circumstances, very different phenomena were observed. By acting with pentachloride of phosphorus upon such a mixture, the hydrochlorate of a new organic base was obtained, the constitution of which was very closely related to that already mentioned as having been produced by the action of chloroform upon aniline. The following equation represented the formation of this salt:—

$$(C_6H_5)(C_2H_3O)HN + (C_6H_5)H_2N + PCl_5 = PCl_3O +$$
$$(C_6H_5)_2(C_2H_3)'''HN_2,HCl + HCl.$$

This salt combines with one atom of bichloride of platinum. The base itself, diphenyl-acyl-diamine, is a magnificently crystalline compound, and is built up as follows:—

$$\left.\begin{matrix}C_6H_5\\ C_6H_5\\ (C_2H_3)'''\\ H\end{matrix}\right\} N_2.$$

Diphenyl-acyl-diamine is non-acid, forming a series of well-defined salts. The speaker pointed out the infinite variety of well-defined diamines which it was possible to produce by applying this process to the amides of the host of monamines already known; and other bases (*e.g.*, the ethyl bases) are likely to give similar results. The last papers of Gerhardt, published since his lamented death, indicate that he was working in this direction: his experiments were made by bringing the chloride of phosphorus in contact with the amide itself; whereas the method which the speaker proposed to adopt was that of employing mixtures, so as to weld two molecules of the same monamine, or two different monamine molecules into one single compound of a higher order.

Dr. Odling having inquired how acet-diamine should be viewed in relation to the new base—

Dr. Hofmann resumed the subject by pointing out that Mr. Strecker had shown that acetamide yet retained to some extent its basic character, and compounds, both with hydrochloric acid and nitrate of silver, were known. By distilling the hydrochlorate of acetamide, Mr. Strecker had obtained the hydrochlorate of a base called ace-diamine, related to diphenyl-acyl-diamine, as cyanide of ammonium to diphenyl-formyl-diamine. As soon, however, as an attempt was made to liberate a base, the compound was decomposed with evolution of ammonia and formation of an acetate, thus,—

$$\left.\begin{matrix}(C_2H_3)'''\\ H\\ H\\ H\end{matrix}\right\} N_2 + 2H_2O = C_2H_4O_2 + 2NH_3.$$

The Secretary read a brief note from Dr. Hermann Kolbe, referring to the conversion of malic acid into malonic acid, and propionic acid into succinic acid.

Dr. Hugo Muller gave a detailed account of some experiments he had been making in the same direction. Wishing to substitute cyanogen for chlorine in chloracetic ether, he had placed that substance in contact with cyanide of silver, but they did not react; he had been, however, partially successful in repeating the experiment with the iod-acetate of ethyl, and had formed in this manner cyano-acetic ether. The cyanide of mercury did not act upon chloracetic ether, but an alcoholic solution of cyanide of potassium formed immediately the alkaline chloride, and by evaporating the solution a product having a high boiling point was obtained, from which alcoholic potash disengaged ammonia, and by adding acetic acid and then lime to the solution the difficultly soluble malonate of calcium was precipitated. In like manner the speaker had succeeded in transforming chloro-propionic acid into succinic acid. The analyses were not completed, but there was no difficulty in recognising succinic acid as having been formed by this process, for it gave off on heating the characteristic cough-provoking vapours, and furnished the usual precipitate with perchloride of iron. The reaction must, therefore, be as follows:—

$$C_2H_3ClO_2 + K_2CN + 2H_2O = K_2Cl + NH_3 + C_4H_6O_4.$$

The President trusted that Dr. Müller would draw up an account of his experiments, so that these independent observations might be published simultaneously.

In reply to the President's inquiry, Dr. Muller stated that the malonic acid produced in this manner was not isomeric, but identical with that prepared from other sources. It crystallised, but the properties were not well known; such was, in fact, the reason of his delaying the publication of these researches, for he was desirous of studying more fully the chemical characters of the acid in question.

The Secretary then read a paper "*On a New Class of Organic Sulphur Compounds*," by Baron Oefele, student in Professor Kolbe's laboratory. (The formulæ of the substances named in the author's communication were given on the older plan, C = 6, which gave rise to some diversion, as Dr. Odling proceeded unwillingly to write them on the board.) The author had described in Liebig's *Annalen*, 1863, the action of oxygen in converting the mono-sulphide of ethyl into diethyl-sulphone thus—

$$\left.\begin{matrix}C_4H_5\\ C_4H_5\end{matrix}\right\} S_2 \text{ became } \left.\begin{matrix}C_4H_5\\ C_4H_5\end{matrix}\right\} S_2O_4.$$

The constitution of sulpho-benzide and propione were similar—

$$\left.\begin{matrix}C_{12}H_5\\ C_{12}H_5\end{matrix}\right\} S_2O_4. \qquad \left.\begin{matrix}C_4H_5\\ C_4H_5\end{matrix}\right\} C_2O_2.$$

The fact which the author had now to communicate was the possibility of forming a direct combination of the mono-sulphide of ethyl with iodide of ethyl, which body, under the influence of nitrate of silver, gave a salt of triethyl-sulphyl, and with oxide of silver the hydrated base—

$$\left.\begin{matrix}C_4H_5\\ C_4H_5\end{matrix}\right\} S_2 + C_4H_5I = \left.\begin{matrix}C_4H_5\\ C_4H_5\\ C_4H_5\end{matrix}\right\} S_2I.$$

The composition of the platinum salt was as follows:—

$$\left.\begin{matrix}C_4H_5\\ C_4H_5\\ C_4H_5\end{matrix}\right\} S_2Cl,PtCl_2.$$

The President then invited Dr. Hofmann to favour the Society with an account of some agricultural results which he had engaged to communicate on the part of M. George Ville.

Dr. A. W. Hofmann stated that he had lately received from M. Ville an interesting account of some experiments which were made for the purpose of ascertaining how far the condition in which an element occurs influences vegetation. In other words, the author had endeavoured to ascertain the best form in which phosphorus, nitrogen, and other elements could be applied as manure to support the growth of plants. The results obtained, which in some instances were very remarkable, were indicated by the stature and development of the plants grown under these varying circumstances, and were made available for inspection and comparison by means of a very beautiful series of photographs of the actual plants, executed upon an uniform scale of dimensions. Proceeding to the examples, the author had taken, for instance, bone phosphate, phosphite of lime, and hypophosphite of lime, each in the proportion of equal weights of phosphorus contained in the salt. These had been separately mixed with ignited sand, and an amount of nitrate of potash corresponding to 0·11 gramme of nitrogen, and in earthen pots filled with such artificial soils the grains of wheat were sown. On reference to the photographs (three mounted on one card), it could easily be seen that the common bone phosphate far outstripped the others, and these latter exhibited a difference in favour of the phosphite. The wheat plants weighed (in grammes) as follows :—

	Straw and Roots.	Grains of Corn.
Phosphate of lime . .	17·	4·
Phosphite of lime . .	3·	0·2
Hypophosphite of lime .	1·	none.

Similar experiments, in which the nitrate and nitrite of potash were compared as before with wheat, the amount of nitrogen in the salts remaining 0·11 gramme, gave results in favour of the common saltpetre ; thus :—

WHEAT.

	Straw and Roots.	Grains.
Nitrate of potash . .	16·	6·
Nitrite of potash . .	4·	1·

BUCKWHEAT.

	Straw and Roots.	Grains.
Nitrate of potash . .	8·	3·
Nitrite of potash . .	3·	1·

COLZA.

Nitrate of potash . .	5 grms.	(entire plant.)
Nitrite of potash . .	2 ,,	do.

Using nitrogenous manures in the form of salts of ammonia, ethylamine, and methylamine, they were found to be practically identical in the cases of wheat, barley, and buckwheat ; but colza grown with sal-ammoniac, chloride of ethylammonium, and chloride of tetrethylammonium, showed results greatly in favour of the common ammonia, and the last-named salt proved almost useless. Colza grew well with ordinary urea, but could not be raised with ethyl-urea. Again, the cyanate of potash did not answer nearly so well as urea. From a consideration of this circumstance, the author was inclined to state the following as being the "vegeto-formula" of urea, viz. :—

$$\left.\begin{matrix}CO\\H_2\\H_2\end{matrix}\right\}N_2.$$

The author had, finally, compared urea with oxalate of ammonia and oxamide, and found their efficiency to be in this order.

The PRESIDENT considered the Society must feel greatly indebted to M. Ville for a communication of such interest, and which was, moreover, so well illustrated by means of photography, and to Dr. Hofmann, also, for the able manner in which he had laid before them these results, the original account of which was written in a foreign language. With regard to the experiments with hypophosphite of calcium and cyanate of potassium, he thought the conclusions a little open to criticism, for in these cases decompositions would occur, and the effects be ascribed to a wrong cause. The cyanate would, in fact, soon be converted into the carbonates of ammonia and potash.

Dr. HOFMANN was grieved to find that the oxide of tetrethylammonium had not realised the expectations which the admirers of this compound had formed of it. There seemed, however, one point conclusively established in these trials—viz., that this base was a kind of potash, and, not being decomposed, could not furnish the nitrogen required for the growth of the plant.

Dr. DE LA RUE inquired whether there was any reference to the use of nitrate of ammonia in the author's paper ? (No mention was made of this salt.)

Dr. GILBERT had made trial with nine acres of wheat of nitrates in comparison with ammonia, and found that, by employing them in equivalent proportions, their action was identical.

Dr. VOELCKER took objection to the plan upon which the author had been working. He conceived that, instead of investigating the action of the compound ammonias and other bodies that were never likely to be employed in agriculture, there would have been great advantage in attacking first some of the simpler problems, and giving, in this way, a more practical turn to the whole question.

Dr. HOFMANN could not altogether agree with the last speaker. He thought the "cui bono" had been lately so often and well answered in this Society, that it might now be fairly assumed to be finally uttered. Aniline and the compound ammonias were not likely to be used in the place of farm-yard manure ; but he conceived it to be perfectly legitimate to examine whether these substances could be assimilated with plants. He was much impressed with the good maxim taught, more than a hundred years ago, by Boerhave, to the effect that "all created things are useful ;" and he concluded by quoting an amusing passage from Boerhave's lectures, in which the distinguished chemist expresses his opinion of the usefulness of phosphorus in his time.

The PRESIDENT then announced the programme relative to the changes in the Council, which would be proposed for adoption at the anniversary meeting on March 30. The name of Dr. Stenhouse was to be substituted for that of Dr. H. Bence Jones, who retires from the vice-presidency ; and the new members of Council were to be Dr. Maxwell Simpson, Mr. Dugald Campbell, Mr. Way, and Mr. Nicholson.

The meeting of the Society was then adjourned until March 3, when a paper "*On the Non-Metallic Impurities of Commercial Copper,*" by the Chemist of the War Department, would be read.

NOTICES OF BOOKS.

International Exhibition : Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. HOFMANN, F.R.S., LL.D., &c., &c.

(THIRTEENTH NOTICE.)

(Continued from page 95.)

THE part of this Report relating to the coal tar dyes is one of the most interesting in the book. Those of our readers who visited the Exhibition do not need to have recalled to their minds the superb and brilliant displays in the eastern annexe ; and to those who had not the good fortune to see the Exhibition, any description would fail to depict those "crimsons of the most gorgeous intensity, the purples of more than Tyrian magnificence, and blues ranging from light azure to the deepest cobalt ;" and "contrasted with these, the most delicate roseate hues, shading by imperceptible gradations to the softest tints of violet and mauve." Added to these was the magnificent appearance of the crystallised dyes themselves, which will not soon be forgotten by those who saw them before their lustre had been dimmed by time and exposure. And all these had "the same prime origin," viz., the noisome tar which stood, in ugly contrast, beside them.

Before addressing himself to the chemistry of their metamorphosis, the author offers some remarks on the economical bearings of the subject, and its probable commercial consequences. These are already of some importance; but the author looks forward to a not far distant day when "this infant industry will enable us to match exactly, with its coal-derived equivalent, each of the various tones of colour previously derivable only from costly vegetal and animal sources, such as tinctorial insects, barks, roots, and flowers." How the murexide crimson from uric has been obtained from picric acid (a coal derivative) we have lately shown, and this is probably only one of a long series of similar triumphs, which may have a most important influence on the industrial fortunes of Great Britain.

"For if coal be destined sooner or later to supersede, as the primary source of colour, all the costly dye-woods hitherto consumed in the ornamentation of textile fabrics—if this singular chemical revolution, so far from being at all remote, is at this moment in the very act and progress of gradual accomplishment—are we not on the eve of profound modifications in the commercial relations between the great colour-consuming and colour-producing regions of the globe? Eventualities, which it would be presumptuous to predict as certain, it may be permissible and prudent to forecast as probable; and there is fair reason to believe it probable that, before the period for another decennial exhibition shall arrive, England will have learned to depend, for the materials of the colour she so largely employs, mainly, if not wholly, on her own fossil stores. Indeed, to the chemical mind it cannot be doubtful that in the coal beneath her feet lie waiting to be drawn forth, even as the statue lies waiting in the quarry, the fossil equivalents of the long series of costly dye materials for which she has hitherto remained the tributary of fossil climes. Instead of disbursing her annual millions for these substances, England will, beyond all question, at no distant day, become herself the great colour-producing country in the world; nay, by strangest of revolutions, she may, ere long, send her coal-derived blues to indigo-growing India, her tar-distilled crimson to cochineal-producing Mexico, and her fossil substitutes for quercitron and safflower to China, Japan, and the other countries whence these articles are now derived."

The last of these prophecies is already accomplished. We export large quantities of aniline red to China, and the importation of safflower has considerably diminished. How largely the trade in cochineal has been influenced may be seen from our Custom House returns, published within the last few days:—

"In the year ended December 31, 1862, the quantity of cochineal imported into this country was 22,760 cwts. Compared with the returns for 1861, a falling-off is apparent of 7253 cwts., notwithstanding which there is a declension in price, and which has continued since the year 1858 (the year in which aniline red was first produced), when the range was from 21*l.* 7s. 10d. to 21*l.* 14s. 11d. per cwt; whereas in 1862 it was only from 13*l.* 8s. 7d. to 14*l.* 18s. 6d. per cwt."

Diminished imports and declining prices tell their tale of absence of demand.

We have not space here for the complete list of the substances obtained by the distillation of coal, but will find room shortly, since it may prove interesting to some of our readers to whom this report is not accessible.

The history of aniline and benzole, and the transformation of the one into the other, has been already told more than once in our pages, so we shall not stop to recount it again, but pass on at once to the coloured derivatives. The account of aniline violet offers but little of novelty. Our readers must be well acquainted with the various processes patented for its production, not many of which, however, are practically employed. The great objection, which, indeed, applies at present to all, is the very small quantity of aniline converted into colouring matter. "When we consider," says the Report, "that from one hundred parts of aniline not more than four or five parts of violet can at present be prepared, all the rest being converted into comparatively worthless tarry products; and, moreover, that the present process must always be carried out on a comparatively small scale, we cannot help thinking that the really rational and convenient mode of transforming aniline into mauve still remains to be devised."

One novelty we meet with here is the *violet impériale* of Girard and De Laire. It is made by heating equal quantities of dry hydrochlorate of rosaniline and of aniline to a temperature of 180° C. If not more than four kilogrammes of the mixture are heated at a time, the operation is complete in about four hours. This colour is considerably employed in dyeing and printing. It rivals mauve in beauty, but is less fast. Its composition is unknown. Mr. Nicholson has obtained a similar violet by carefully heating aniline red in a suitable apparatus to a temperature between 200° and 215° C., whereby the red substance is transformed into a dark substance, with evolution of ammonia. The dye is dissolved out of the mass with acetic acid.

The account of aniline red is of considerable length, and we defer it until next week.

Tables of Chemical Formulæ. Arranged by W. Odling, M.B., F.R.S., &c. &c. London: Taylor and Francis. 1864.

This is a very useful compilation, which would have been made still more useful if it had been prefaced by a short introduction giving an account of the systems adopted by the author. The first table, for example, requires, for ordinary students, an explanation of the term "Perissad," which Dr. Odling applies to a certain class of elements. They are, in fact, those which combine with 1, 3, 5, and 7 (all odd numbers) of chlorine; and so, perhaps, these elements may be very appropriately called "Perissads" (*περισσος*, an odd number), as opposed to another class which combine with 2, 4, and 6 of chlorine, and here denominated "Artiads" (*αρτιος*, even). There is a third class, iron, manganese, &c., which combine with both odd and even numbers, and are called "Periss-artiads."

Even without these explanations, however, the tables will be found extremely useful to both teachers and students. They comprise tables of the atomic weights and symbols of the elements, carefully classed and grouped, a table of illustrative simple oxides, atomic heat, equivalent notation, vapour densities, normal and anomalous, and many others which exhibit great industry and ingenuity on the part of the compiler.

We strongly recommend a study of the tables to all who wish to master the difficulties of modern chemical notation.

NOTICES OF PATENTS.

2853. *Obtaining Fresh Water by Evaporation.* A. Chaplin and G. Russell. Glasgow. Dated October 23, 1862.

With the object of more effectually aërating the water obtained by distillation, and thereby improving its flavour, the inventors direct a jet of steam, under considerable pressure, into the condensing apparatus, and allow it to serve as an aspirator in drawing in a current of air, which, freely surrounding the aqueous particles at the moment of condensation, are more quickly absorbed.

2856. *Treating Alkali Waste to Obtain Sulphur therefrom.* Edward Bath, Swansea. Dated October 23, 1862. (Not proceeded with.)

The object of this invention is the recovery of sulphur from the refuse oxysulphides obtained in the alkali manufacture, and, at the same time, to economise the sulphur which, in the form of sulphurous acid, is poured into the atmosphere of Swansea from the chimneys of the copper smelting works. The principle on which the process of recovery is based is that involved in the mutual decomposition of sulphurous acid gas and sulphuretted hydrogen, which, when brought into contact, give rise to the formation of water and precipitation of the whole of the sulphur. The operation is carried out by erecting a tower or shaft filled with smooth pebbles, over and through which a slow stream of water is allowed to descend; connected with the bottom of this tower is an apparatus wherein the alkali waste is treated with crude muriatic acid, and the sulphuretted hydrogen so generated is allowed to escape into the shaft, which is at the same time freely open to receive the sulphurous gas disengaged from the furnaces in which copper ores are undergoing calcination. The proportions of the two gases admitted should be so regulated that neither should greatly preponderate; under these circumstances the process may be made continuous, the escaping water furnishing an index of the proper working of the stack, for in the event of one gas being in excess it will be immediately manifested by the smell of the water.

A process such as the above would be invaluable if means could be devised for establishing and maintaining a powerful current of air through the entire arrangement, so as not to interfere at all with the proper action of the calcining furnaces. It would be important also to find an application for the chloride of calcium formed as the secondary product.

Grants of Provisional Protection for Six Months.

10. Jean Louis Prosper Duroy, Faubourg Montmartre, Paris, "An improved method of manufacturing soap with a vegetable basis."—Petition recorded January 2, 1864.

58. Bernhard Samuelson, Banbury, Oxford, "An improvement in smelting iron ore."

66. James Gibbins, Lawn Villas, South Lambeth, Surrey, "Manufacturing a composition which will render railway and other tarpaulins, rick cloths, waggon covers, gig, omnibus, and all other carriage aprons and covers, whether composed of canvass, leather, or other material, perfectly waterproof and non-combustible."

80. William Clark, Chancery Lane, London, "Improvements in the means of obtaining or preparing fibrous material from vegetable matters."—A communication from Hubert Dupré, Boulevart St. Martin, Paris.

3131. Ernest Solvay, Brussels, Belgium, "Apparatus by means of which the formation of carbonates of soda by direct combination is rendered practically available for manufacturing purposes."—Petition recorded December 11, 1863.

5. William Clark, Chancery Lane, London, "Improvements in the manufacture of chlorine."—A communication from Francois Marie Aubert de Tregomain, Boulevart St. Martin, Paris.—Petitions recorded January 1, 1864.

109. John Edward Baker, Birmingham, "Improvements in retorts and furnaces for distilling coal and other solid hydro-carbons, for the manufacture of volatile oils therefrom, which improvements may also be applied to retorts and furnaces used for other purposes."

120. David Auguste Burr, Southampton Buildings, Chancery-lane, London, "Improvements in lightning arresters for protecting electric telegraph apparatus."—A communication from George Stearns, Rochester, New York, U.S.

125. Jacob Jehoshaphat Salter Mountain, St. Heliers, Jersey, "New or improved means of obtaining motive power, by the combination of steam power with atmospheric or hydraulic pressure, or with both."

131. Carl Vogt, Cassel, Hesse, "Improvements in the manufacture of pigments."—A communication from Ludwig Schad, Cassel, Hesse.

152. Thomas Lightfoot and John Lightfoot, Accrington, Lancashire, and George Powell Barnes, Manchester, "Improvements in fixing colours on woven fabrics or fibrous materials."

163. Edgar Townend Jarrold, Norwich, Norfolk, and George John Yates, Penketh, near Warrington, Lancashire, "Improvements in deodorising paraffin, petroleum, rock, shale, and other hydrocarbon oils."

203. William Ibotson, Wraysbury, Buckinghamshire, "An improvement in the process of bleaching materials for paper making."

225. John Henry Johnson, Lincoln's Inn Fields, London, "Improvement in stopping bottles containing aërated liquids."—A communication from Edward Hamilton, Chicago, U.S.—Petitions recorded January 26, 1864.

Notices to Proceed.

2371. William Clark, Chancery Lane, London, "An improved fabric for the production of permanent electricity, applicable for wearing apparel."—A communication from Theodore Courant, Boulevart St. Martin, Paris.—Petition recorded September 26, 1863.

MISCELLANEOUS.

Patent Laws.—At the annual meeting of the Association of Chambers of Commerce, held on Tuesday last, Mr. Wright moved, "That the granting of patents for improvements and discoveries in manufactures is right in principle, and has been found beneficial in operation." Colonel Akroyd seconded the motion; and, after an amendment to the effect that the patent laws ought to be abolished had been negatived, the original motion was carried.

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

J. N.—The crystals are sulphate of lime. Your solution was not made with distilled water.

Photo.—We shall have a paper on the manufacture of bromides shortly.

D. Z.—Our correspondent is no doubt right as to the absence of novelty in the patent.

W. B.—We cannot give the information. A patent agent will supply it.

Mr. Geldard is thanked for his communication. 1. Acetate of soda is added to ensure the precipitation of all the iron. 2. "Peroxidises" was of course a clerical error for "oxidises," overlooked. It is the hydrogen of the hydrochloric acid which is oxidised in the solution—not the iron.

A Correspondent has copied the following receipt from a patent dated September 7, 1860, and wishes to know how the ingredients can be combined so as to form the "impermeable oil varnish which possesses the advantage of being impervious to water, of rendering the object varnished extremely pliable, and of giving it a brilliant polish," as promised in the specification:

100 parts Alcohol.
100 „ Spirits of turpentine.
1 „ Sulphuric ether.
1 „ Carbonate of soda.

We must frankly confess our inability to give our correspondent the information he asks, and recommend him to write to M. Antoine Bovet, of Paris, who alone can possess the valuable secret. What the chemist sent was exactly what we should have expected to see.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Calabar Bean, by J. JOBST *and* O. HESSE.

THE physiological properties of the Calabar bean have been well studied in this country, but the authors above named are, we believe, the first who have isolated the alkaloid to which it owes its activity, and to which they have given the name *Phytostigmine.*

The poison is found only in the cotyledon, and is extracted in the following way:—The decorticated beans, well pulverised, are exhausted by repeated treatment with boiling alcohol (80 per cent.). On cooling, the alcoholic solution becomes slightly turbid, and on evaporation yields a yellowish residue, which gives a cloudy solution with water, from the separation of some oil. Calcined magnesia is now added to the aqueous solution until no acid reaction is exhibited, and a brown colour is produced; the mixture is then evaporated by a gentle heat. While still moist, the residue is repeatedly shaken up with ether until all the brown colour is removed. The mixed ethers are then filtered, and a few drops of dilute sulphuric acid are added. In this way two layers are obtained; the upper consisting of an etherial solution of oil and other inactive ingredients of the bean, and the lower of an aqueous solution of sulphate of phytostigmine. The latter, carefully separated from the ether, may be again precipitated by magnesia, and the alkaloid extracted with ether; and lastly, the etherial solution evaporated.

In this way phytostigmin is obtained as a brownish-yellow amorphous mass, which first separates in oily drops, easily soluble in alkalies, ether, benzol, and alcohol, and slightly soluble in cold water. The alkaloid is completely separated from the etherial solution by animal charcoal. The aqueous solution has a slightly acrid taste, and a decidedly alkaline reaction. With biniodide of potassium it gives a rich kermes-coloured precipitate; and from perchloride of iron it throws down the hydrated peroxide of iron. Fused with potash, the alkaloid gives off strongly alkaline vapours. Acids dissolve it easily, giving for the most part dark red, and less often dark blue salt solutions, which are more or less decolorised by sulphuretted hydrogen.

The hydrochlorate, sulphate, and acetate, have been obtained as a red amorphous masses, easily soluble in alcohol and water. The hydrochlorate gives the following reactions:—

With *tannic acid*, a considerable reddish-white amorphous flocculent precipitate; difficultly soluble in hydrochloric acid.

With *chloride of platinum*, a pale yellow amorphous precipitate; easily soluble in hydrochloric acid and boiling water.

Chloride of gold gives a bluish precipitate. After a short time gold separates, and the solution becomes purple red.

Chloride of mercury produces a reddish-white precipitate; easily soluble in hydrochloric acid; insoluble in the chloride of mercury.

The quantity of phytostigmine obtained by the authors was insufficient for a complete analysis. Their experiments leave no doubt that the alkaloid is the active principle of the bean.

One curious fact observed by them was, that the poison produces contraction of the pupil when applied to recently dead animals. They placed two drops of the aqueous solution of the alkaloid in one eye of a rabbit which had been dead (not poisoned) an hour, and, in consequence, the pupil of this eye contracted to one-fourth (compared with the other eye), and remained in this condition.

TECHNICAL CHEMISTRY.

Arguments for and against Prolonged Vatting in the Fabrication of Wine—Alcoholic Fermentation during the Process, by M. A. BÉCHAMP.

VATTING may be defined as—leaving the wine for a longer or shorter time on the skins, or on both the skins and stalks of the grapes.

Experience has taught me that prolonged vatting is never injurious; on the contrary, very perfect wines are obtained in this way, if one condition be attended to—carefully to avoid contact with the air.

Both old and recent writers insist strongly on the necessity of immediate removal from the vat, that is to say, "as soon as the first subsidence of the head becomes apparent, or when the fermentation, having attained its maximum, begins to decrease."

Whilst the fermentation is active, the whole of the contents of the tun is impregnated with carbonic acid, and the tun itself is filled with it. During this time, the stirred-up residuum (the head), the froth, and the wine are preserved from the influence of the air, and the still more pernicious influence of the germs brought by it. If, then, the wine is unvatted as soon as the head begins to subside, or as soon as the fermentation ceases to be active, it will evidently escape the influence of the germs which may be developed in the head. There is, no other reason for premature removal from the vat though, in my opinion, the cause of this absolute necessity has not been sufficiently inquired into.

But is it clearly proved that mouldiness is developed in the head and froth as soon as the fermentation becomes less active? This is the fact, and an annoying one, too.

During the autumn of 1862 I assured myself of the formation of this mouldiness. One of my fermentations was effected with the same grape as that which had served in former experiments (in which the fermentation took place sheltered from the air), but in which the air had had access through a very small aperture. The vatting was not very prolonged, and I ascertained the presence of mouldiness in nearly the whole depth of the stirred-up residuum. The wine thus obtained was not at all good, and would not keep. It was less alcoholic, and contained more extractive matters than wines I made with the air excluded; those were excellent; they kept well, and improved by keeping, and yet the vatting lasted from one to three months. It may, perhaps, be supposed that this method will not serve in wine-making on a large scale. This is an error. Under conditions much more unfavourable, as the fermentation subsides, mould is developed, and this development corresponds to the relative height of the temperature of the tun or vat, so that its effect should be much more detrimental than was the case in my experiment, in which the temperature was less high.

I had an opportunity of verifying this fact during this year's vintage. In some fermentations of 21,000 and 28,000 litres, not a single tun did I see in which the head, at the seventh day, was not impregnated with various kinds of mould of globuliform ferments, differing from the yeast of beer, and from the many ferments of different forms understood by the term *filiform*, which I last year observed in my laboratory fermentations.

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* Abstract from *Annalen der Chem. und Pharm.*, Bd. cxxix., s. 115.

The same holds good with the scum of tons wherein white wine has been made. As soon as the air enters freely into the tuns, which is inevitably the case when the quantity of carbonic acid is no longer large enough to successfully oppose its entrance, it becomes charged with these little organisms.

The rapid formation of these productions has been regarded as sufficient reason for quickly unvatting; and herein we find the explanation of the practice bequeathed to us from the observation and experience of our forefathers.

The immediate consequence is, that if we wish to avoid the influence of these organisms, we must unvat before their development, that is to say, before the active fermentation is at an end. We should thus fall into the opposite extreme, and all extremes are bad.

From my point of view the following disadvantages arise from prolonged vatting:—I have remarked that in fermentations to which the air had access, the head quickly becomes pale, while the flavour of the residuum is disagreeable, and not altogether vinous. This condition augments until the whole of the head becomes musty, which speedily takes place on account of its porosity. Two days after the cessation of the tumultuous fermentation, the stirred-up residuum is musty to the depth of more than a decimetre. The wine may thus become tainted, and, as the head is porous, the vatting, however managed, takes with the wine, besides the mould, the altered matters of the head. Hence, I believe, the disagreeable flavour of wines obtained in this way—the roughness and earthy taste, which are absent in wines made with the air excluded.

For the rest I have advanced nothing which I cannot verify. In wines unvatted at the eighth day, especially in pressed wines, even in those fermented in tons sufficiently closed to prevent the free access of the air, I ascertained the presence of myriads of ferments of various forms.

From all this, it results that, to avoid the access of air, it is necessary to unvat as speedily as possible, at the risk of obtaining incompletely fermented products, and so—according to M. Dumas—to finish the ferment in full tuns, as in champagne.

My observations have suggested to me the following means for facilitating more prolonged vatting. It will doubtless be long before the present method undergoes any alteration, since it is founded on principles different to those I put forward. To keep the head from contact with the air, and to fulfil the conditions similar to those of fermentations in closed vessels, the following is, I believe, the best mode of proceeding:—

Immerse the head by pouring some of the wine on it; before the fermentation abates, fill the vat up to the bung; close carefully, so that only a very small portion of scum may be exposed to the air. For this purpose the wine may be drawn from a neighbouring vat while the fermentation is still active, or on the point of ceasing to be so. For this purpose a tun or vat should be provided for each kind of wine, and as soon as it becomes empty, the residuum should be pressed and divided among the tuns, where the fermentation is finished with almost absolute exclusion of air. The combination of this method with those I have proposed in my six recent studies on alcoholic fermentation during wine-making, seems to resolve the question in a manner which, if not the best, is at least the most economical. Some of these facts appear to me to be new, and some forgotten; they are condensed in the following conclusions:—

1. Cane sugar is not a sugar, for it possesses neither the property of fermenting directly, nor of reducing M. Barreswil's reagent. Like dextrine it combines with the elements of water, and is converted into glucose, under the influence of acids or of a ferment.

2. Some time ago I showed that the glucosic ferment of cane sugar is spontaneously developed by the germination of the germs brought by the air in solutions of this body; thus proving that cane sugar may be transformed into glucose by other means than by acids.

3. Beer yeast, by itself, serving as a must in the first moment of its action on cane sugar, behaves like a double compound ferment, analogous to cane sugar.

4. Ferments are formed from germs in the air in a medium wherein sugar and albuminoid matter coexist. This is the result of my investigations on the development of mould in sugared water, and their subsequent action on cane-sugar.

5. Following M. Dumas' suggestion, I admit that the ferment is an organised being, existing and nourished in the same manner as animals.

6. Alcoholic fermentation by the influence of the ferment on sugared water, without the addition of an albuminoid matter in a suitable state, is an abnormal action; for the organised being cannot then normally develop, be nourished, and multiply.

7. During fermentation in a simply sugared medium, the globules multiply and increase only by supporting themselves on the materials furnished by their predecessors. Thus, the ferment, whilst multiplying itself, gives, in absolute weight, less product than was employed in the first instance. I speak, of course, of fermentations not too prolonged, and for which a sufficient quantity of leaven has been used.

8. According to M. Dumas, the fermentation is not complete unless the ferment is properly maintained.

9. During the physiological process involved in the life of a ferment in the fermentable medium, disengagement of heat takes place. The elevation of the temperature is in proportion to the fermenting mass the quantity of ferment (that is to say, the number of individuals which consume), and to the original temperature of the mixture and of the surrounding medium. This, to me, seems a consequence of the nature, rather animal than vegetable, of the cellule of the ferment.

10. In the most physiological conditions of the fermentation, there is necessarily a formation of acetic and other volatile acids.

11. If volatile acids are formed during the alcoholic fermentation, the odoriferous ethers of these acids ought to be developed, and are so, in fact, under all circumstances.

12. The formation of ferment in the must of grapes has a two-fold result. The ferment eliminates, by rendering insoluble, the albuminoid matter of the grape, and transforms the sugar as well as the other materials of the must.

13. Wine normally and duly made contains no properly so-called albuminoid matter.

14. In the fermentation of grape juice, the sugar is not always completely transformed, because the medium becomes too complex. It has been ascertained by an experiment, that sugar is integrally transformed only when the must contains hardly more than 200 grammes per litre; and during the fermentation of wort the sugar furnishes more alcohol and less carbonic acid than is required by theory.

15. Chaptal says that Le Gentil and Poitovin mention the elevation of the temperature during the fermentation of the grape; it rises in proportion to the heat of the

place in which the wine is made, and the largeness of the mass fermented. It must be borne in mind that great inconvenience attends too copious a disengagement of heat during vinous fermentation.

16. The considerable disengagement of heat augments the volume of carbonic acid, and entails the loss of alcohol and etherised volatile compounds formed during the fermentation, and which contribute to form the bouquet of wine.

17. I have proved the formation of etherised compounds with fruity odours during vinous fermentation; likewise during artificial fermentation, and that as a consequence of the formation of volatile acids.

18. The development of heat diminishing in proportion to the smallness of the bulk fermented, and the lowness of the temperature, it follows that the mass fermented should not be too large.

19. I have advised prolonged vatting; but to render this advantageous, all contact with air should be avoided.

20. I have described the detrimental influence of the air, and the formation of mouldiness in the head, formed by the stirred-up residuum in tuns where fermentation is effected with the skins or with both skins and stalks; and to this mouldiness I attribute the alteration in the materials of these residuums, and afterwards in the wine itself. Through the porosity of the head and the mould, oxygen is readily absorbed, and the residuum acetified.

21. M. Dumas long ago indicated the spontaneous production of whitish mucors in wines as a cause of their rapid deterioration.—*Comptes Rendus*, lvii., 674. 63.

Theoretical Researches on the Preparation of Soda by Leblanc's Process, by M. A. Scheurer-Kestner.

Oxysulphide of Calcium.—The absence of any definite reaction between the insoluble sulphuretted part of rough soda and solutions of carbonate of soda has led M. Dumas to admit the existence of a compound of sulphide and oxide of calcium, supposed to be insoluble in water.

But sulphide of calcium is itself very little soluble in water; from experiments made with the greatest care it results that water at 12° C., dissolves only $\frac{1}{13500}$th of this body, prepared by calcining sulphate of calcium with charcoal. The sulphide of calcium was previously washed with alcohol, to eliminate the small quantities of polysulphides which it nearly always contains.

Pure sulphide of calcium put in contact with solutions of carbonate of sodium gradually transforms this salt into sulphide; but double decomposition between the two salts is very slow.

By treating with water simultaneously and under the same conditions, powdered rough soda and a mixture in given proportions of carbonate of sodium and sulphide of calcium, the solutions at the end of an equal length of time contained the same quantities of sulphide of sodium.

The hypothesis of the existence of insoluble oxysulphide of calcium is, then, not necessary to account for the inertness of residuums in solutions of rough soda. Moreover, the result is the same from leaving rough soda long in contact with water. The solution thus obtained is more charged with sulphide of sodium, but the insoluble residuums no longer contain oxide of calcium. By estimating the calcium, sulphur, and carbonic acid in it, we shall find that we have to deal only with a mixture of carbonate and sulphide of calcium.

In this case, also, it is observed that the causticity of the liquids considerably increases; the carbonate of sodium being decomposed by the hydrate of calcium gradually formed by the oxide. Were the oxide of calcium combined with the sulphide to form oxysulphide, the sulphide of sodium would increase in the liquids in proportion to the caustic soda, but experiment shows the contrary.

Caustic Soda contained in Solutions.—The presence of caustic soda in solutions of rough soda led to the supposition that this body exists in the product before undergoing the action of water—a necessary consequence this of the hypothesis of oxysulphide of calcium. From the fact that alcohol does not dissolve caustic soda when digested with rough soda, M. Gossage concludes that this body is formed during the solution in water, and hence he denies the existence of oxysulphide. To obviate this difficulty M. Kynaston admits the formation of an insoluble compound of sulphide and carbonate of calcium, formed by the action of the water, simultaneously with caustic soda. But the absence of caustic soda in alcohol only proves that rough soda is free from hydrate of sodium, while it may contain anhydrous oxide of sodium, a body insoluble in alcohol.

As it is proved that oxysulphide of calcium does not exist, it may be admitted that caustic soda forms only during the action of water; this is, in fact, shown in estimating the carbonic acid contained in rough soda; the quantity of this acid found in it is always greater than is necessary for the saturation of the sodium. A portion of the limestone even remains intact. The partial decomposition of the excess of limestone employed in the preparation of rough soda accounts for the variations in causticity observed in liquids obtained with soda by different operations. An evident proof of the formation of caustic soda during solution in water is, that the water carries off from the rough soda itself the whole of the sodium and variable proportions of caustic soda, depending only on the duration of the contact of the insoluble residuums with the solution.

Origin of Soluble Sulphides.—MM. Gossage and Kynaston are of opinion that the soluble sulphides contained in solutions of rough soda pre-exist in this product in the state of polysulphide of calcium, and that by simply avoiding the formation of these polysulphides while preparing the soda, pure liquids are to be obtained. But these polysulphides should dissolve in alcohol, while well-made rough soda yields to this liquid only traces (0·005 to 0·006 per 100 parts of rough soda) of monosulphide of sodium in quantity much less than is to be found afterwards in solutions of this same soda washed in alcohol.

The sulphide of sodium contained in solutions of rough soda are derived chiefly from a partial double decomposition which takes place between the dissolved sulphide of calcium and carbonate of sodium. Polysulphides exist in rough soda which has been subjected to too high a temperature, not as salts of calcium, but as salts of sodium. Sodium and sulphur are present in proportions corresponding to the disulphide of sodium, as may be seen by analysing the alcoholic solution of this soda. Disulphide of sodium is formed by the reduction at a high temperature of carbonate of sodium on sulphide of calcium, according to the following equation:—

$$\underbrace{2Ca_2S}_{\substack{\text{Sulphide}\\\text{of calcium.}}} + \underbrace{Na_2\bar{C}\bar{O}_3}_{\substack{\text{Carbonate}\\\text{of sodium.}}} = \underbrace{Na_2S_2}_{\substack{\text{Disulphide}\\\text{of sodium.}}} + \underbrace{\bar{C}\bar{O}}_{\substack{\text{Oxide}\\\text{of carbon.}}} + \underbrace{2Ca_2\bar{O}.}_{\substack{\text{Oxide}\\\text{of calcium.}}}$$

Rough soda containing disulphide of sodium produces solutions containing a large quantity of caustic soda. The excess of caustic soda is produced by the oxide of calcium formed simultaneously with the disulphide of sodium. Moreover, it happens often that soda which has undergone too high a temperature contains oxide of sodium formed by the reduction of carbonate by charcoal.

Thus the hypothetical existence of oxysulphide of calcium is not necessary to explain the small degree of reaction which takes place between solutions of rough soda and insoluble residue. This residue is formed by a mixture of carbonate and sulphide, or of carbonate, oxide, and sulphide of calcium. The caustic soda contained in solutions of rough soda is formed by the action of the hydrate of calcium of the insoluble residues on carbonate of sodium; but when rough soda has been brought to a high temperature it may contain oxide of sodium formed by the reduction of the carbonate. Soluble sulphides are the product of a partial reaction between carbonate of sodium and sulphide of calcium in water. Moreover, rough soda which has been submitted to a high temperature contains polysulphides of sodium, but never polysulphides of calcium.

It remains to be determined which reaction effects the transformation of sulphate of sodium and chalk into sulphide of calcium and carbonate of sodium, and why it should be necessary to employ an excess of calcium, without which carbonate of sodium charged with sulphide is obtained.—*Comptes Rendus*, lvii., 1013.

PHARMACY, TOXICOLOGY, &c.

Tannin, its Employment as a Substitute for Cinchona.

UNDER this title, Dr. Leriche has published a memoir, which received a silver medal from the Society of Medical Sciences of Brussels.

The author arrives at the following conclusions:—

1. Pure tannic acid, properly administered, is an excellent anti-periodic.

2. It possesses real efficacy in the treatment of all intermittent fevers of a simple quotidian type.

3. The facility of its extraction, its low price, its innocuousness, render it preferable to sulphate of quinine, or at least to the other derivatives of cinchona.

4. It consequently unites all the qualities of a good succedaneum, and constitutes, at the present time, the best of indigenous febrifuges.—*Journ. de Chimie Médicale.*

On a New Kind of Cubebs.

WITHIN a brief period, cubebs from the Dutch East Indies have entered commerce; they are attributable to an analogous species, and are offered at a much lower price than ordinary cubebs. But they differ essentially from true cubebs, and must be considered as false and improper for medical employment. M. Pas, as well as M. Grœnewegan, have examined them. The size of this cubeb surpasses considerably that of black pepper, and is nearer that of allspice. Its colour is ash-grey, approaching brownish black, and the wrinkles on the surface are less deep and more regular than those of true cubebs; the petioles are a little flattened. The odour is less agreeable, and the taste less burning, less pungent, and more like mace.

Thrown into water, the new cubeb absorbs it more rapidly, and precipitates, consequently, much sooner than ordinary cubebs. It colours the water deep brown, whilst true cubebs gives it but a light yellow, after several days' contact. Maceration in water softens both fruit and seed, which is not the case with cubebs.

True cubebs are difficult to powder; the false drug is easily reduced to powder. The true powder is deep brown, of an aromatic odour, whilst its congenor is greyish-red, with a terebinthinate odour. The volatile oil of this berry possesses a sharp odour, resembling a mixture of flower of nutmegs, lemons, and oil of turpentine, and is colourless, whilst that of cubebs is thicker and greenish coloured.

A hundred parts of true cubebs yield twenty-one of a greenish balsamic extract to ether; whilst, in the same manner treated, the false drug gave but ten parts of a brownish balsamic extract. M. Pas thinks this drug is the ripe fruit of *Piper cubeba*, whilst M. Grœnewegan thinks they are the product of *Piper anisatum.—Journ. de Chim. Méd. et Journ. de Ph. d'Anvers.*

Note on Some Properties of Berberine,
by WILLIAM PROCTER, *Jr.*

HAVING occasion recently for information relative to the properties of pure berberine in an uncombined state, a reference to all the authorities at my disposal, including nearly all the papers published within the last few years, I noticed with some surprise that these writers, in describing berberine, treated the substance obtained from *Berberis vulgaris* by the agency of neutral solvents, and which, as berberine is an alkaloid, must be a natural salt of that substance.

Buchner, the original discoverer of this principle, believed it to be a neutral substance. Liebig (*Traité de Chemie*, tome ii., 645,) says it is alkaline, but in describing its preparation, gives the original process, and describes its solubility in the form of its natural salt, as requiring 500 parts of cold water. Wittstein, in his "Practical Pharmaceutical Chemistry," (Darby's translation), also describes it in this condition as obtained by neutral solvents, and gives the same numbers for solubility that Liebig does. He also says that this natural salt is the hydrochlorate, a statement I have not seen elsewhere. I have consulted the papers of Fleitman, of Stenhouse, and of Perrins, in the *Pharmaceutical Journal*, and those of Mahla and Merrill in the *American Journal of Pharmacy*, and none of them describe the properties of pure berberine.

The best process for isolating berberine is that hinted at by William A. Merrill (*Amer. Jour. Pharm.*, p. 503, 1862), based on the separation of the sulphuric acid from the sulphate by either baryta or oxide of lead. Mr. Merrill prefers the oxide of lead, and I agree with him, as, from its insolubility in water, its excess does not interfere with the purity of the resulting alkaloid in solution.

Take the root of *Hydrastis canadensis*, or of *Berberis vulgaris*, preferably the former, in coarse powder, exhaust it by repeated decoction or digestion in boiling water, and evaporate the filtered liquids to a soft extract. Treat this with stronger alcohol by digestion in a water-bath still at several times until it is exhausted (or until a quart of alcohol has been employed for the extract from each pound of the root). Add to the tincture one-fourth of its bulk of water, distil off five-sixths of the alcohol, and add to the hot watery residue an excess of diluted sulphuric acid, and allow it to cool. The sulphate of berberine crystallises out, and, if necessary, may be drained from the mother-liquid, re-dissolved in the smallest quantity of boiling water, and again crystallised.

The salt is now ready for decomposition by oxide of lead. The latter, as obtained by precipitation from the acetate or nitrate of lead by liquor potassæ, and well washed, and is added in excess, with agitation, to the sulphate of berberine dissolved in boiling water, the solution being kept hot during the decomposition. When a drop of the hot clear liquid will not be precipitated by baryta water or acetate of lead, the digestion is finished. The solution should then be filtered off hot, evaporated, and set aside for crystallisation.

Examined by a lens, berberine crystallises in stellated groups of minute acicular crystals, not so deep in colour as those of the muriate of commerce, or Eclectic *hydrastin.* A grain of berberine, placed in a test tube, was shaken with repeated additions of water at about 60° F., with intervals of rest, during twenty-four hours, until it had nearly all dissolved—which required seventy-five grains of water. The residue completely dissolved when the quantity was increased to 100 grains. The solution thus obtained was a clear and brilliant yellow colour. When a grain is dissolved by heat in seventy-five grains of water, the excess crystallises out on standing. Berberine is much more soluble in boiling water and in hot alcohol, but it is less soluble in cold alcohol than in water, one grain requiring more than 100 grains of that liquid for solution. Storer, in his "Dictionary of Solubilities," page 67, gives Liebig's numbers for the solubility of berberine, which apply to its hydrochlorate according to Wittstein. It is soluble in acetone and methylic alcohol, whilst chloroform dissolves it but slightly, and ether, oil of turpentine, and oil of almonds, not at all. Acetic acid is one of its best solvents. It is also soluble in cold sulphuric acid, which it colours deep yellow. Nitric acid instantly decomposes berberine, with the production of a dark, mulberry-purple colour, which grows lighter by standing. This reaction is best shown by adding a minute fragment of nitrate of potassa to the solution of berberine in sulphuric acid, when the rich mulberry colour is instantly developed.

When a particle of bichromate of potassa is employed, the colour is much darker, almost purplish-black, and remains so for some time. The saturated aqueous solution yields beautiful crystalline precipitates, with diluted nitric, muriatic, and sulphuric acids, but not with phosphoric, acetic, citric, or tartaric acids. Aqueous iodine renders it opaque, and affords a brown precipitate; tannic acid and iodohydrargyrate of potassium, each a yellow one.

Both the watery and alcoholic solutions have a strong bitter taste. The existence of berberine in several of the natural orders of plants is quite remarkable, and suggests to Mr. Perrins that it probably possesses more valuable properties as a medicine than have yet been accorded to it.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, January 29, 1864.

Colonel Philip James Yorke, *F.R.S., in the Chair.*

Edward Frankland, Esq., F.R.S., Professor of Chemistry, Royal Institution, read a paper "*On the Glacial Epoch.*"

Amongst the circumstances that have profoundly influenced the present physical condition of our earth, the action of ancient glaciers upon a scale of almost inconceivable magnitude has been gradually but irresistibly forcing itself upon the notice of philosophers since their attention was first called to it by Venetz and Esmark. There are few elevated regions in any quarter of the globe which do not exhibit indubitable evidence of the characteristic grinding and polishing action of ice-masses, although at present, perhaps, they are scarcely streaked by the snows of winter. In our own country the researches of Buckland, and especially of Ramsay, have clearly shown that the Highlands of Scotland, the mountains of Wales and Cumberland, and the limestone crags of Yorkshire, abound in these *roches moutonnés*, which leave no doubt that the valleys of those mountain ranges were once filled with glaciers of dimensions unsurpassed, if even equalled, by those which at the present day stream down the sides of their gigantic Swiss rivals. Nor was this perpetual ice of a former age confined to localities where no such phenomenon is now seen, but numerous observations have established that the glaciers of the present age, existing in Switzerland, Norway, and elsewhere, are but the nearly dried-up streamlets of ancient ice rivers of enormous size. These glaciers have eroded the Alpine valleys, of which they once held possession, have carved out the lochs and kyles of Scotland, as well as the grander fjords of Norway, and have contributed in a most essential manner to the present aspect of our mountain scenery. Ramsay and Tyndall have recently called attention to this action of ancient glaciers, and have contended with considerable plausibility, the former that the lake basins, the latter that the valleys of the Alps, have been thus, in great part, scooped out. In no part of the world, perhaps, can the phenomena of the glacial epoch be more advantageously studied than in Norway, where the ice-scarred coasts and fjords are still fully exposed to the eye of the observer, side by side with the ocean, which furnished the crystalline material that formerly covered them. Two thousand miles of coast, from Christiania to the North Cape, afford almost uninterrupted evidence of the vast ice operations which, during the epoch in question, moulded nearly every feature of this remarkable country. Starting from Christiania, the traveller cannot fail to remark the peculiar appearance of the gneiss and granite rocks composing the coast, as well as the innumerable islands which, forming a great natural breakwater, protect the shore from the heavy seas rolling in from the Atlantic. These rocks, here rarely rising to the height of 800 or 900 feet, present nothing of that sharp and rugged outline which generally characterises such formations. On the contrary, they are smoothed even to their summits, all their angles worn off, and every trace of boldness and asperity effaced. To the casual and uninstructed observer the action of the sea suggests itself as a sufficient cause of these appearances; but it does not require much scrutiny to be convinced that the ocean waves have had little to do with this smoothing and polishing of the coast, since it is the surfaces sloping towards the land that are most acted upon, whilst in some places, where the rock descends precipitously towards the sea, and is subject to the dash of the waves, it has been protected from the abrading action, and presents merely a weathered surface.

Rounding the promontory of the Naze, and proceeding northward, the coast presents, with slight exceptions, the same general features until the Arctic circle is approached, when the character of the scenery rather suddenly changes. The rocky hills acquire the dignity of mountains, and tower up in rugged, sharp, and fantastic peaks, contrasting strongly with the rounded summits of the lower latitudes. But these arctic peaks owe their immunity from the abrading action of ice solely to their height; around their bases, and even high up their sides, the slow surges of the moving glacial sea have made their unmistakable marks, grinding, and even undercutting, them into most extraordinary forms, as fine instances of which may be mentioned the Seven Sisters, and Torghatten, with its singular tunnel, just south of the Arctic circle; the Horseman, standing on the circle; and the mountains of the Folden and Vestfjords, north of it; the latter having been justly described by the Rev. R. Everest, as resembling the jaws of an immense shark.*

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* The speaker was greatly indebted to his friend, B. F. Duppa, Esq., for beautiful coloured drawings of these remarkable objects, taken from the sketches of Professor James D. Forbes and Mr. Mattieu Williams.

To account for the advent and subsequent disappearance of such vast masses of ice, various hypotheses have been propounded. It has been suggested that the temperature of space is not uniform, and that our solar system, in performing its proper motion among the stars, sometimes passes through regions of comparatively low temperature; according to this hypothesis, the glacial epoch occurred during the passage of our system through such a cold portion of space. Some have imagined that the heat emitted by the sun is subject to variation, and that the glacial epoch happened during what may be termed a cold solar period. Others, again, believed that a different distribution of land and water would render the climate of certain localities colder than it is at present, and would thus sufficiently account for the phenomena of the glacial epoch. Finally, Professor Kamtz considers that at the time of the glacial period the mountains were much higher than at present—Mount Blanc 20,000 feet, for instance—the second and tertiary formations having been since eroded from their summits.

The two last assumptions are attended with formidable geological difficulties, especially when it is considered that the phenomena of the epoch in question extended over the entire surface of the globe; they have, therefore, never acquired more than a very partial acceptance. With regard to the two first-named hypotheses, my colleague, Professor Tyndall, has recently shown that they are founded upon an entirely erroneous conception of the conditions necessary to the phenomena sought to be explained. The formation of glaciers is a true process of distillation, requiring heat as much as cold for its due performance. The produce of a still would be diminished, not increased, by an absolute reduction of temperature. A greater differentiation of temperature is what is required to stimulate the operation into greater activity. Professor Tyndall does not suggest any cause for such exalted differentiation during the glacial epoch; but he proves conclusively that both hypotheses, besides being totally unsupported by cosmical facts, are not only incompetent to constitute such a cause, but also assume a condition of things which would cut off the glaciers at their source, by diminishing the evaporation upon which their existence essentially depends.

The speaker divided the great natural glacial apparatus into three parts, viz., the evaporator, the condenser, and the receiver. The part performed by the ocean as the evaporator is too obvious to need description. The two remaining portions of the apparatus, however, are generally confounded with each other. The mountains are in reality the receivers, or icebearers, and are only in a subordinate sense condensers. The true condenser is the dry air of the upper region of the atmosphere, which permits of the free radiation into space of the heat from aqueous vapour.†

All the hypotheses hitherto propounded having therefore failed in the light of recent research, to account for the conditions which brought about the glacial epoch, the speaker felt less reluctance in advancing a new theory, which had gradually elaborated itself out of the impressions he had received during a recent visit to Norway. Any such theory must take cognisance of the following points in the history of the glacial epoch:—1st, That its effects were felt over the entire globe. 2nd, That it occurred at a geologically recent period. 3rd, That it was preceded by a period of indefinite duration, in which glacial action was either altogether wanting, or was at least comparatively insignificant. 4th, That during its continuance atmospheric precipitation was much greater, and the height of the snow-line considerably less than at present. 5th, That it was followed by a period extending to the present time, when glacial action became again insignificant.

All these conditions he believed to be the natural sequences of the gradual secular cooling of the surface of our globe. The sole cause of the phenomena of the glacial epoch was a higher temperature of the ocean than that which obtains at present.

He then examined the grounds upon which this hypothesis is based. Numerous observations of the augmentation of temperature, at increasing depths from the surface of the earth, no longer leave room for doubt that the vast mass of materials constituting the interior of our globe is at the present moment at a temperature far higher than that of the surface. If this be so, the conclusion is almost inevitable, that at earlier periods of the earth's history this high temperature must, at all events at depths comparatively little removed from the surface, have been still higher, and that consequently the temperature of the surface itself must in former ages have been much more influenced by the internal heat than is the case at the present day. Tracing thus back the thermal history of our earth, it is conceivable that the waters of the ocean once existed as aqueous vapour in our atmosphere—a condition which it is imagined obtains at the present day in Jupiter, Venus, and other planets, whose superior size or closer proximity to the sun may be supposed to have retarded the refrigeration of their surfaces. From the period, therefore, when the cooling of the earth's crust permitted the ocean to assume the liquid condition, its waters have gradually cooled from the boiling point down to the present temperature, whilst the land has also undergone a similar process of refrigeration. It was during the later stages of this cooling operation that the glacial epoch occurred. For this assumption, however, it is necessary to establish that the rate of cooling of the land and of the ocean surfaces was unequal, otherwise the more rapid evaporation of the ocean due to increased temperature would be more or less neutralised by the impaired efficiency of the proportionately warm icebearers. The speaker then proceeded to describe the results of his numerous experiments, which conclusively proved that, under the conditions contemplated, the land would cool more rapidly than the sea. This effect is brought about principally by two causes, viz., the great specific heat of water compared with granite and other rocks, and the comparative facility with which radiant heat escapes from granite through moist air. The amounts of heat associated with equal weights of water and granite are as 5 to 1 in favour of the former, or, if equal volumes be taken, the water requires to lose twice as much heat as the granite in order to cool through the same number of degrees; but it is in regard to the escape of radiant heat from their surfaces that the superior retention of warmth by the oceanic waters is most strongly marked. The readiness with which radiant heat escapes from equal surfaces of water and granite at the same temperature through perfectly dry air is nearly equal; but so soon as aqueous vapour is interposed in the path of these rays, the conditions become wonderfully altered; the escape of heat from both is interrupted, but its radiation from the water is retarded in by far the greatest degree. This extraordinary intransealency of aqueous vapour to rays issuing from water has just been conclusively proved in the physical laboratory of this Institution by researches made by Professor Tyndall, and not yet published. The difference between granite and water arising from this cause becomes vastly augmented when it is considered that the icebearing surfaces occupy an elevated position above the level of the sea, consequently the mantle of aqueous vapour which their radiant heat had to penetrate must have been much more attenuated than the comparatively dense shell lying between them and the surface of the ocean. Thus the obscure rays of heat streamed into space from the icebearing surfaces with comparatively little interruption, whilst the radiation from the sea was as effectually retarded as if the latter had been protected with a thick envelope of non-conducting material.

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† This radiation from aqueous vapour was experimentally shown by causing a jet of dry steam to pass in front of, and at a distance of two feet from, a thermo electric pile; the galvanometer connected with the latter promptly showed a large deflection for heat, proving that the pile was receiving radiant heat from the aqueous vapour. A jet of air heated in the same manner and projected in front of the pile produced no such effect.

Whether we take into consideration, therefore, the conductivity of water and granite, their specific heats, or, finally, the respective facilities with which they can, under the cosmical conditions contemplated, throw off their heat into space, we find everywhere a state of things tending much more to the conservation of the heat of the water than to the retention of that of the land; and this of course applies also, *mutatis mutandis*, to the retention of that heat which is received from solar radiation. The luminous heat-rays of the sun pass freely through aqueous vapour, and are absorbed by both granitic and oceanic surfaces, but, once absorbed, these rays issue forth again as obscure heat of two different qualities, or rates of vibration. To use Tyndall's beautiful explanation of the phenomenon, the vibrations of the liquid water molecules are of such rapidity as can be best taken up and absorbed by the same molecules in the vaporous condition. But granite is a very complex substance, and fewer of the heat oscillations of its atoms are in unison with those of aqueous vapour: hence the heat vibrations of granite disturb the molecules of aqueous vapour in their passage through the atmosphere in a less degree, and consequently the granitic rays are less absorbed.

Thus, whilst the ocean retained a temperature considerably higher than at present, the icebearers had undergone a considerably greater refrigeration. The evaporation from the ocean would therefore, at the period contemplated, be greater than it is at present, whilst the capabilities of the icebearers, as such, would not be perceptibly less. Moreover, it is evident that during the whole of the cooling period the ocean must have been receiving heat from its floor, and thus have acted as a carrier of warmth from the comparatively profound portions of the earth's crust to the oceanic surface. It thus resembled a mass of water contained in an evaporating basin, placed over a very slow and gradually declining fire. Under such conditions its cooling was protracted through a vast period, allowing sufficient time, between a temperature inimical to animal life and the commencement of the glacial epoch, to permit of the development and decay of those forms of animal life which existed in the preglacial seas.

The rate of evaporation of water at different temperatures and under various circumstances was determined by Dalton, whose results are embodied in the following table. The evaporation took place in each case from a circular surface six inches in diameter:—

Temp. F.	Evaporation per minute in Calm. grains.	Evaporation per minute in Breeze. grains.	Evaporation per minute in High Wind. grains.
85°	4·92	6·49	8·04
75°	3·65	4·68	5·72
65°	2·62	3·37	4·12
55°	1·90	2·43	2·98
45°	1·36	1·75	2·13
35°	·95	1·22	1·49

We have no sufficient data to calculate the present mean temperature of the ocean, but in lat. 69° 40′ off the coast of Norway, at noon on a remarkably hot summer's day, Professor Forbes found the temperature to be 46·5° Fahr. The assumption of 40° Fahr. as the mean temperature off the coast of Norway would, therefore, probably be in excess of the truth. Now, taking the mean of Dalton's results obtained at 35° and 45°, and comparing it with the mean of his results at 55° and 65°, it will be seen that an increase of 20° in the temperature of the ocean off the coast of Norway would double the evaporation from a given surface. Such an increased evaporation, accompanied as it necessarily must be by a corresponding precipitation, would suffice to supply the higher portions of the land with that gigantic ice-burthen which groaned down the mountain slopes during the glacial epoch.

But would not the increased oceanic temperature tend to augment the mean temperature of the atmosphere even at considerable elevations, and thus raise the snow-line and reduce the area of perpetual snow? In answering this question, the speaker showed that the limit of perpetual snow does not depend so much upon the mean temperature of the atmosphere at that particular elevation, as upon the amount of snow accumulating during the cold season. Under the equator, the mean temperature of the snow-line is 35° F.; in the Alps and Pyrenees, about 25°; and in lat. 68°, in Norway, it is only 21°. Thus the mean temperature of the snow-line rises as we approach the equator, which means that the snow-line itself descends below its normal height, owing principally to augmented oceanic evaporation, accompanied by increased atmospheric precipitation. The deluges of rain which fall within the tropics far surpass the rainfall in the temperate and frigid zones, and doubtless the fall of snow upon intertropical mountains is proportionately great. The important influence which the amount of precipitation exercises upon the lower limit of perpetual snow is beautifully exemplified at the fine waterfall of Tysse Strenger, near the head of the Hardanger Fjord, and was first noticed by Mr. M. Williams. The spray from this fall, being frozen in winter, covers the valley for nearly half a mile with a stratum of snow and ice, so thick as to defy the solar rays of summer to melt it; thus lowering the snow-line by more than 2000 feet. The speaker had also seen in the Sör Fjord, under similar abnormal conditions, a mass of snow lying, in the month of August last, within 10 feet of the level of the sea, although the normal snow-line is there at least 4500 feet above the sea-level. That the height of the snow-line is essentially dependent upon the amount of precipitation, and not upon mean temperature, is evident from a comparison of its height on the coast and in the interior of the Scandinavian peninsula, as given by Forbes in the following table, compiled partly from his own observations and partly from those of Von Buch, Naumann, and others:—

Latitude.	Height of Snow-line in feet. Coast.	Interior.	Difference.
60°	5500	4450	1050
62°	5200	4150	1050
64°	4200	3650	550
66°	3700	3250	450
68°	3450	3000	450
70°	3350	2900	450

Thus the difference between the height of the snow-line near the coast, where, owing to the impact of the gulf-stream, the winter is mild but the atmospheric precipitation great, and in the interior, where the climate is severe but the air comparatively dry, amounts, in some cases, to as much as 1050 feet, or nearly one-fourth of the total height. Such is the depressing effect of greater precipitation as regards the limit of perpetual snow. Nor must it be forgotten that copious precipitation is altogether incompatible with great summer-heat. The incessantly-clouded sky cuts off the solar rays, and moderates the summer temperature. It is a trite observation that a wet summer is always a cold one. The mean temperature of the land in contiguity with such extensive surfaces of snow could also not fail to be considerably reduced; for, although the actual amount of heat in activity at the surface of the earth was greater during the glacial period than subsequently, yet the cold of winter became stored up in masses of falling snow, which in melting absorbed the heat of the succeeding summer, and thus reduced both the mean and summer temperature of the land, especially of such portions of it as were not situated greatly below the snow-line. The common notion, therefore, that the glacial epoch was a cold one is correct, although heat, not cold, was the cause of that epoch. This apparent paradox, that heat should be the cause of cold, finds its parallel in the ice-making machines which were in operation at the last Great Exhibition. In those machines which produced from 2 to 12 tons of ice per ton of coal, the glacial produce was directly proportional to the amount of heat developed by the combustion of coal.

But it is evident that this lowering of the snow-line by increased oceanic temperature could only occur within certain limits; for, although the mean temperature of the snow-line might rise from 21°, its present position in Norway, to 35°, its height under the equator, and perhaps even still higher, without any elevation of the snow-line itself; yet a further rise of mean temperature, which would result from a continued augmentation of oceanic heat, could not fail to elevate the snow-line itself, and eventually to chase the last portions of snow even from the loftiest mountain peaks. A process the inverse of this has gone on in nature, leading gradually to the glacial epoch, and eventually to the present meteorological condition of our globe. Whilst the ocean maintained a high temperature, the snow-line floated above the summits, possibly even of the most lofty mountains; but with the reduction of oceanic temperature it gradually descended, enveloping peak after peak in a perennial mantle, until during the glacial epoch it attained its lowest depression, whence it again rose, owing to diminished evaporation, to its present position.

The speaker considered that, inasmuch as recent researches had rendered all previous hypotheses regarding the glacial epoch absolutely untenable, the one for which he now contended could not be said to come into antagonism with any other views. It also further commended itself by requiring the assumption of no natural convulsion or catastrophe, no vast or sudden upheavals or depressions, and no change in the thermal relations of our earth to the sun or to space. On the contrary, it insisted that the glacial epoch was normally and gradually evolved from a thermal condition of the interior of our globe, which could scarcely be said to be any longer the subject of controversy.

In conclusion, this hypothesis suggests the probability that the other bodies belonging to our solar system have either already passed through a similar epoch, or are destined still to encounter it. With the exception of the polar ice of Mars we have hitherto obtained no certain glimpse into the thermal or meteorological condition of the planets: neither is the physical state of their surfaces accessible to our best telescopes. It is otherwise however with the moon, whose distance is not too great to prevent the visibility of comparatively minute details. A careful observation of the lunar surface for more than a year with a silvered glass reflector of seven inches' aperture and of good defining power, had created in the speaker's mind an impression that our satellite had, like its primary, also passed through a glacial epoch, and that several at least of the valleys, rills, and streaks of the lunar surface were not improbably due to former glacial action. Notwithstanding the excellent definition of modern telescopes, it could not be expected that other than the most gigantic of the characteristic details of an ancient glacier hed would be rendered visible. Under favourable circumstances the terminal moraine of a glacier attains to enormous dimensions; and consequently, of all the marks of a glacial valley, this would be the one most likely to be first perceived. Two such terminal moraines, one of them a double one, appeared to him to be traceable upon the moon's surface. The first was situated near the termination of that remarkable streak which commences near the base of Tycho, and passing under the south-eastern wall of Bullialdus, into the ring of which it appears to cut, is gradually lost after passing crater 216 (Lubinietzky). Exactly opposite the last crater, and extending nearly across the streak in question, are two ridges forming the arcs of circles, whose centres are not coincident, and whose external curvature is towards the north. Beyond the second ridge a talus slopes gradually down northwards to the general level of the lunar surface, the whole presenting an appearance reminding the observer of the concentric moraines of the Rhone glacier. These ridges are visible for the whole period during which that portion of the moon's surface is illuminated, but it is only about the third day after the first quarter and at the corresponding phase of the waning moon (when the sun's rays falling nearly horizontally, throw the details of this part of the surface into strong relief) that these appearances suggest the explanation now offered.

The other ridge, answering to a terminal moraine, occurs at the northern extremity of that magnificent valley which runs past the eastern edge of Rheita. This ridge is nearly semicircular, and is considerably elevated, both above the northern termination of the valley, and the general surface of the moon. It may be seen about four days after new and full moon, but the position of the observer, with regard to the lights and shadows, renders its appearance in the rays of the rising sun by far the most striking.

With regard to the probability of former glacial, or even aqueous, agency on the surface of the moon, difficulties of an apparently very formidable character present themselves. There is not only now no evidence whatever of the presence of water, in any one of its three forms, at the lunar surface; but, on the contrary, all selenographic observations tend to prove its absence. Nevertheless, the idea of former aqueous agency in the moon is by no means new. It was entertained by Gruithuisen and others. But if water at one time existed on the surface of the moon, whither has it disappeared? If we assume, in accordance with the nebular hypothesis, that the portions of matter composing respectively the earth and the moon once possessed an equally elevated temperature, it almost necessarily follows that the moon, owing to the comparative smallness of its mass, would cool much more rapidly than the earth; for whilst the volume of the moon is only about $\frac{1}{49}$th, its surface is nearly $\frac{1}{13}$th, that of the earth.

This cooling of the mass of the moon must, according to all analogy, have been attended with contraction, which can scarcely be conceived as occurring without the development of a cavernous structure in the interior. Much of this cavernous structure would doubtless communicate by means of fissures with the surface, and thus there would be provided an internal receptacle for the ocean, from the depths of which even the burning sun of the long lunar day would be totally unable to dislodge more than traces of aqueous vapour. A globe of wax was exhibited which had been cast under water; it was highly cellular, and the water had been forced into the hollow spaces, completely filling them. Assuming the solid mass of the moon to contract on cooling at the same rate as granite, its refrigeration through only 180° F. would create cellular space equal to nearly 14½ millions of cubic miles, which would be more than sufficient to engulf the whole of the lunar ocean, supposing it to bear the same proportion to the mass of the moon as our own ocean bears to that of the earth.

If such be the present condition of the moon, we can scarcely avoid the conclusion that a liquid ocean can only exist upon the surface of a planet, so long as the latter retains a high internal temperature. The moon then becomes to us a prophetic picture of the ultimate fate which awaits our earth, when deprived of an external ocean and of all but an annual rotation upon its axis,[‡] it shall revolve around the sun an arid and lifeless wilderness,—one hemisphere exposed to the perpetual glare of a cloudless sun, the other clouded in eternal night.

[‡] Mayer has recently proved that the action of the tides tends to arrest the motion of the earth upon its axis. And although it has been proved that since the time of Hipparchus the length of the terrestrial day has not increased by the one hundredth part of a second, yet this fact obviously leaves untouched the conclusion to which Mayer's reasoning leads.

ACADEMY OF SCIENCES.

February 22.

M. **Moride** communicated "*A Process for Reviving Writing almost Effaced upon Deeds and Parchments.*" He first soaks the parchment in distilled water; after draining, he immerses it for a second or two in a weak solution of oxalic acid; he then rapidly washes it, and afterwards places it in a closed vessel containing a solution of gallic acid (10 grammes to 300 grammes of distilled water); finally, as soon as the characters appear, he well washes the manuscript with a large quantity of water, and dries it between leaves of blotting paper. These operations require great care and delicacy, or the manuscript may become hopelessly defaced, especially if it be left too long in the gallic acid solution, exposed to the influence of air and light. The Academy, in fact, condemns it, and says that librarians and keepers of archives would not be justified in performing this experiment upon public documents.

M. E. **Renou** communicated a note "*On the Limits of Perpetual Snow.*" The author announces his discovery of the following law:—"In all countries in the world the limit of perpetual snow is the height at which the hottest half of the year has a mean temperature equal to that of melting ice." The observations hitherto made are so defective, and the decrease of temperature with height, in different seasons, are so little known, that the author does not hope to completely verify the law, but he shows that there is an agreement as satisfactory as possible in the present state of our knowledge.

A note "*On the Atomicity of Oxygen, Sulphur, Selenium, and Tellurium,*" by M. A. **Naquet**, was presented. The author is disposed to consider all these elements tetra-atomic. His reasoning is curious, and we shall translate the note at length.

CHEMICAL SOCIETY OF PARIS.

January 22, 1864,

M. **Ad. Wurtz** *in the Chair.*

In commencing the business of the evening, M. **Wurtz** expressed his thanks to the Society for the honour they had conferred upon him, and briefly glanced over the services which had been rendered to science by his predecessor, M. H. Deville.

MM. Vidal, Descamps, and Lacote were elected resident members, and M. J. Riban was elected "non-resident" member.

M. **Friedel** read the report of the committee on accounts. Their conclusions were adopted.

M. **Berthelot** gave an account of his researches on the oxidation of wine.

M. **Riban**, in presenting to the Society a memoir on the active principle of the Redoul (Sumach), briefly mentioned his researches, and exhibited a fine specimen of crystallised coryamirtine.

M. **De Luynes** announced that he had succeeded in solidifying butylene.

M. **De Luynes** gave an account of some researches undertaken by him, in conjunction with M. G. Salet, on the employment of hydriodic acid in organic chemistry.

M. **Cloez** described a method of analysing organic acids, when combined with potash or soda. The organic matter is mixed with tungstic acid, and burned in a current of pure and dry air.

M. **Cloez** also announced a means of separating glucose from chloride of sodium, by the employment of acetate of silver. The soda is precipitated with concentrated oxalic acid, and the evaporated solution extracted with alcohol, which only dissolves the glucose.

M. **Wurtz** gave an account of several results obtained by M. Carina on the fixation of hypochlorous acid and oxygenated water on hydrocarbons. They recall an observation of Mr. Attfield, who has shown that oxygenated water, in uniting with hydrocyanic acid, forms oxamide.

PHARMACEUTICAL SOCIETY.

February 17.

Dr. **Redwood** delivered a lecture on the British Pharmacopœia, which was listened to with great satisfaction by a crowded audience. After a brief historical allusion to the pharmacopœias which have been superseded by the British, the lecturer proceeded to give a short general sketch of the changes made in the chemical preparations, and then referred to some preparations which he considered to require particular notice. *Acidum Aceticum Glaciale* he said could not be obtained by the process given in the Pharmacopœia, and he regretted that the Committee had not rested satisfied, as in the case of acetic acid, with describing the article they intended. The increase of strength in the mineral acids the lecturer considered disadvantageous. The new hydrochloric acid has a greater tendency to give off vapours when exposed to the air. To the nitric acid stronger objections applied. Acid of the gravity 1·5 is not a commercial product; it will not keep colourless, for it is constantly undergoing decomposition, under the influence of light, losing strength, and becoming contaminated with nitrous acids. The sulphuric acid is described as monohydrated, but the gravity given is the gravity of a weaker acid. The process directed for obtaining the acid will not yield the monohydrated, which Dr. Redwood considered a fortunate circumstance, since this acid congeals in cold weather, and would be inconvenient to use. The alkalies were next alluded to, and the alterations of strength in the solutions were pointed out. These were shown in the following tables:—

	Ph. Lond.	Ph. Brit.
Liquor ammoniæ . .	0·960	0·959
Liquor ammoniæ fortior .	0·882	0·891
Liquor potassæ . .	1·063	1·058
Liquor sodæ . . .	1·061	1·047

The greatest alteration, it will be seen, has been made in the case of liquor sodæ. The carbonate of potash $KOCO_2 2HO$, described in the British Pharmacopœia, is a salt which cannot be obtained in commerce, and is very difficult to make. Carbonate of potash of commerce contains only about an atom and a-half of water, or sixteen per cent. The process for making tartar emetic Dr. Redwood commended as an improvement. In those for ferrum tartaratum and ferri et ammoniæ citras too much water is ordered, and the dilute solutions obtained cannot be scaled according to the directions. The process for making spiritus ætheris nitrosi might be good if pure nitrite of soda could be obtained. Unfortunately, the process for the preparation of this salt given in the Pharmacopœia does not yield the product required. The samples of the salt examined by the lecturer consisted principally of nitrate of soda, with much carbonate and very little nitrite. The product of the Pharmacopœia process will always be variable, and consequently the spirit of nitre is not likely to be uniform in composition. Collodium was next referred to, and the lecturer said that the process given for making pyroxylin would produce excellent gun-cotton, which will be insoluble in the mixture of alcohol and ether. One other preparation was referred to—distilled water. "The description," Dr. Redwood said, "given of the distilled water directed to be used in pharmacy affords a good illustration of what appears to me to be a defect in many parts of the work, and that is, an attempt at too great refinement. We are told that distilled water should answer to the following character among others—namely, 'that a fluid ounce of it evaporated in a clean glass capsule leaves no visible residue.' Now, I should like to see such distilled water made by simple distillation in a copper still, as described in the Pharmacopœia. In the instruction of pharmaceutical pupils I have been accustomed to set them the task of producing such distilled water, as one which they would think very easy, but which experience proves to be attended with considerable difficulty."

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(FOURTEENTH NOTICE.)

(Continued from page 107.)

Dr. Hofmann very properly claims the discovery of aniline red. The first mention of it will be found in vol. ix., p. 284, of the *Proceedings of the Royal Society*. It was obtained by the action of fuming nitric acid upon aniline. The first industrial process was devised by MM. Verguin and Rénard, of Lyons, who procured the colour by the action of tetrachloride of tin upon aniline. These gentlemen also first applied the colour to dyeing and printing. Numerous processes have since been invented for the production of *rosaniline*, as the colour is now called, most of which have been noticed in our columns. A brief account of them here, however, will not be out of place.

The original process of MM. Rénard Frères was the following:—A mixture of ten parts of aniline and from six to seven of tetrachloride of tin is heated to boiling for fifteen or twenty minutes. The liquid, at first yellow, becomes more and more red, until the mass appears black. A solution in boiling water may be used at once for dyeing; but it is better to purify the colour by neutralising a concentrated solution with carbonate of soda, and then adding a quantity of common salt, whereby the colouring matter is precipitated in a solid state. The precipitate has only to be dissolved in water, alcohol, or acetic acid to prepare a dye for imbuing silk and wool with the most beautiful roseate tints.

Gerber Keller's process soon followed. He treats aniline with mercuric nitrate in the dry. To ten parts of aniline placed in a water-bath, seven or eight parts of the powdered mercuric nitrate are gradually added, with constant stirring. The operation lasts eight or nine hours, at the end of which time the mass becomes of a beautiful violet red colour. This constitutes the azaléine of commerce. This process, the reporter says, may be considered really useful.

Lauth and Depouilly treat aniline with nitric acid. The aniline must be in excess. The mixture must be carefully heated to 150° or 160° C., and the heat must be removed quickly if the action becomes lively, or combustion may take place.

This process succeeds well, but can only be safely conducted on a small scale. After several hours, a mass of violet red is obtained, from which the colouring matter may be separated with carbonate of soda and common salt, as in Rénard's process.

The method by means of arsenic acid the Reporter ranks among the best. Twelve parts of commercial arsenic acid and ten parts of aniline, with or without the addition of water, are heated over a slow fire to about 120° or 140°, taking care not to exceed 160° C., until the mass solidifies on cooling to a hard substance with a bronze-coloured lustre. The operation lasts, according to the quantities used, from four to nine hours. When the bronze-coloured substance is dissolved in water, a solution of great richness is obtained from it; a slight excess of soda will precipitate the colouring matter. The precipitate is filtered off, washed, and redissolved in acetic acid.

A detailed account of this operation as it is carried out by the MM. Rénard, at Lyons, is here extracted from M. Wurtz's report on the colouring matters derived from coal tar, contributed to the reports of the French section of the Jury of the International Exhibition. We quote it here, as probably neither that nor the present report will reach many of our readers who are interested in these colours:—

"A very concentrated solution of arsenic acid, containing 76 per cent. of the solid acid [hydrate or anhydride?], is mixed with aniline, manufactured from either English or Belgian benzol. For twenty parts of the syrupy arsenic acid twelve parts of commercial aniline, which is not anhydrous, are taken, and forty kilogrammes of this mixture are introduced into a cast-iron retort, the dimensions of which, on account of the powerful intumescence during the reaction, should considerably exceed the bulk of the mixture. The retort is placed over the vault of a furnace, where it is heated in an air bath, the temperature of which must not exceed from 150° to 170° C. From time to time a workman plunges a rod into the mass, and as soon as the substance which adheres exhibits on cooling a bronzy colour and a brilliant fracture the operation is terminated. The time required for this purpose varies from three to four hours. The product of the fusion is then poured upon cast-iron plates, from which, after solidification, it is detached, reduced into fragments, and removed to another part of the establishment, in order to be exhausted. For this purpose it is digested in large cast-iron tanks, with twice its weight of hydrochloric acid. The operation lasts from two to two and a-half hours; and, during the whole of this time, a current of steam is passed through the liquid, which becomes rapidly charged with the colouring matter. As soon as the residue has become pulverulent, the liquid is thrown upon a strainer of woollen material. The filtered liquid falls into a large cast-iron vessel, containing an excess of a solution of carbonate of sodium. The colouring matter is thus separated in flakes or granules, which, under the influence of a current of steam, unite and rise to the surface of the liquid, whence it is removed by perforated ladles. The substance thus obtained is introduced into large tanks of cast-iron, and submitted, in the presence of a considerable quantity of water, to the action of a current of steam. A great deal of colouring matter dissolves in the liquid, which is separated by filtration from a new deposit, and allowed to cool in large vessels of iron-plate, in which green crystals of a coppery lustre are deposited.

"If, in the treatment of aniline with arsenic acid, the latter be considerably increased beyond the proportions above given, violet, and even blue colouring matters are produced, the formation of which has been patented by MM. Girard and De Laire."

MM. Laurent and Casthélez have a process by which they transform nitrobenzole into the colouring matter without the preliminary isolation of the aniline. "Nitrobenzole is treated with a mixture of iron and hydrochloric acid, or with ferrous chloride. In this operation the nitrobenzole is converted into aniline, and ferric chloride is produced. On heating this mixture, the ferric chloride reacts upon the aniline, transforming it into aniline red." MM. Laurent and Casthélez have given the name of *erythrobenzole* to the colouring matter thus obtained; but it probably consists principally of rosaniline. This method is ingenious, and if the product be equal, in point of quantity and quality, to that obtained by the previously prepared aniline, it must be an economical plan, since it dispenses entirely with one rather delicate operation, and thus diminishes the amount of labour required.

The above may be called the practical processes for the production of rosaniline. For numerous others, we must refer our readers to this Report, or vol. ii., p. 244, of the Chemical News. At that time we spoke strongly in condemnation of a patent taken out in this country by M. Gerber Keller, in which it seemed to be the object of the patentee to claim everything which could by any possibility produce the colour. Speaking of this particular patent, the Reporter makes the following observations:—"Of such patents scientific men cannot speak otherwise than in terms of reprehension. Their claims are founded on random guesswork, not on the results of patient investigation. They are attempts to pre-occupy the whole field, and forestall all the rewards which should be left open to real inventive genius to cultivate and win. It would [in the Reporter's opinion] be well that such patents, on due proof of their character, should be set aside by the tribunals." We will go further, and state our own opinion that a petition for a patent of this kind should be instantly dismissed.

Before proceeding to the "Researches on the Nature of Aniline Red," we will extract a foot note relating to the production of arsenic acid :—

"This acid was first produced upon a large scale by M. E. Kopp (*Ann. Chem. Phys.*, [3] xlviii., 106), who, during the high price of tartaric acid in the years 1853 and 1854, suggested the employment of arsenic acid for the white discharge of Turkey red,—an application which, to a certain extent, has continued ever since, although the price of tartaric acid has fallen again. M. Kopp employs nitric acid to convert arsenious acid by oxidation into arsenic acid; and, by passing the nitrous acid fumes evolved, together with air, over coke moistened with water, he recovers from two-thirds to three-fourths of the nitric acid employed. The proportions he adopts are 303 kilogrammes of nitric acid of 1·35 sp. gr. to 400 kilogrammes of powdered arsenious acid; and by adding the nitric acid gradually he finds that the oxidising action may be accomplished without the application of heat. The above method is used with advantage by the manufacturers who prepare arsenic acid for the production of rosaniline. The Reporter lately saw this operation at the celebrated works of M. Charles Kestner, at Thann, where 100,000 kilogrammes of arsenic acid, the order of a single manufacturer of aniline red (Messrs. J. J. Müller and Co., of Basle) were in course of preparation. The oxidation was effected in large glass flasks connected with a lead pipe, by which the copiously-evolved nitrous fumes were discharged into one of the leaden chambers on the premises.

"M. Kopp, while working with arsenic acid, made the peculiar observation that, without any detriment to his general health, a natural tendency to *embonpoint* was considerably enhanced during his operations. In the course of ten weeks M. Kopp had increased in weight not less than ten kilogrammes, which he lost again when his experiments with arsenic acid were discontinued. The Reporter has been informed that the work-people engaged in the production of rosaniline are affected in a similar way."

A Manual of Photographic Chemistry, Theoretical and Practical. By J. F. Hardwick. Seventh Edition. Edited by G. Dawson, M.A., &c., and E. Hadow, F.C.S. London: Churchill and Sons. 1864.

It is not necessary to say anything in praise of a book which has reached a seventh edition. A few alterations and additions, however, have been made in this edition which deserve a word of commendation. The editors have done their work extremely well, and the much-respected author still appears as the guide, philosopher, and friend to all photographers who desire to have an intelligent appreciation of the art.

Annalen der Chemie und Pharmacie. February, 1864.

The number of this valuable periodical just received contains several papers of interest. The first, by Strecker, "*On a New Class of Organic Nitrogen Compounds*," gives an account of azobenzoic acid,—an acid obtained from nitrobenzoic acid by the action of sodium amalgam.

$$\underset{\text{Nitrobenzoic acid.}}{C_{14}H_5(NO_4)O_4} + 4Na = \underset{\text{Azobenzoic acid.}}{C_{14}H_5NO_4} + 4Na\Theta.$$

Some of the salts and the ether of this acid are described, as well as a derivative—hydrazobenzoic acid.

A paper "*On Citramalic and Citratartaric Acids*," by Carius, gives a further account of these acids previously described. The same author announces the discovery of a new fatty acid in the glandular secretion of the hyæna, and hence called hyænic acid. It is remarkable for the high number of the carbon, the formula being $C_{25}H_{50}\Theta_2$. Beyond this, and a slight musky smell, it does not seem to possess much interest. A learned paper by Wislicenus, "*On the Poly-Equivalent Organic Acids*," is a valuable contribution to the chemistry and philosophy of substitution products. An important communication by Claus, "*On the Behaviour of Sulphide of Mercury to Sulphide of Ammonium*," contradicts all analytical books by the assertion that the former body is soluble in the latter. We shall translate this paper. A communication on the occurrence of inosite, by Dr. Marmé, shows that this principle is very commonly present in vegetables. August Streny describes fluochromate of potash, a new fluorine compound; and also a tribasic arsenite of lead oxide, $3PbO + AsO_3 + HO$.

A short paper "*On Narceine*," by Hesse, confirms Anderson's analysis of that alkaloid, and describes some of its salts. The same author, in a shorter communication, denies the existence of a volatile alkaloid in arnica. Hugo Schiff contributes a short notice of the colouring matters derived from naphthylamine, showing that the chemical constitution of these and the aniline colours is different.

NOTICES OF PATENTS.

2870. *Bearings, Steps, Axle-boxes, &c.* P. S. Deolan, Buckingham Street, Strand, London. Dated October 24, 1862.

The inventor describes three compositions which are useful for packing steam machinery, and for the linings of bearings, axle-boxes, and other surfaces exposed to friction. No. 1 composition consists of asbestos, or other mineral fibrous substance, incorporated with graphite, talc, or stealite, and any one of a series of gums the addition of which is intended to secure the perfect adhesion of the whole. Of the gums which are suitable for this purpose, the inventor particularly enumerates dextrine, gutta-percha, gums Arabic, tragacanth, and cowrie. No. 2 composition is similar, but, instead of asbestos, the employment of combinations of albumen with leather, or other animal fibrous substance reduced to pulp, or of mixtures containing glue and starch with the unctuous minerals already specified, is recommended. No. 3 composition differs from the foregoing only by the substitution of cotton, hemp, or other fibrous vegetable substance, for the animal and mineral fibres before described.

The comprehensive nature of the claim renders it impossible to avoid the use of anti-friction materials, which, alone or combined in a manner very similar to the above, have already been applied to the purposes herein mentioned. There cannot be any doubt regarding the efficacy of these compositions; and the extent to which they are susceptible of modification by using animal, vegetable, or mineral fibres, according to the heat of the bearings and other circumstances, renders them universally applicable.

2881. *Apparatus for Testing the Explosibility of Liquid Hydro-carbons.* E. A. L. Negretti and J. W. Zambra, Hatton Garden, London. A communication. Dated October 25, 1862. (Not proceeded with.)

This is a little instrument constructed for the purpose of indicating the lowest degree of temperature at which the vapour given off by a liquid hydrocarbon forms an explosive mixture with the air. It consists of a cup or metallic vessel heated by a water bath or naked spirit flame, and a thermometer with its bulb dipping into the liquid to be tested. The apparatus is particularly applicable for testing the safety of paraffine and petroleum oils intended to be burnt in lamps.

2885. *Heating Glass Furnaces.* J. H. Johnson, Lincoln's Inn Fields, London. A communication. Dated October 27, 1862.

The inventor employs for melting glass the waste gases which are given off during the burning of coke. A direct communication is made by means of flues between the coking oven and the glass furnaces, and for the purpose of purifying the combustible gases from sooty particles a fine spray of water is injected by a rose. A blast of air directed through tuyeres into the chamber of the glass furnace urges the combustion of the gaseous fuel.

Grants of Provisional Protection for Six Months.

192. Frederick North, Leeds, Yorkshire, "Improvements in processes and apparatus for treating and preparing peat and turf, and the products obtained therefrom."—A communication from Charles Fluery, Bruxelles.

200. Eugen Lucius, Frankfort-on-the-Maine, Germany, "Improvements in the manufacture and production of colours."—Petitions recorded January 23, 1864.

202. John Piddington, Gracechurch-street, London, "Improvements in the manufacture of paper from straw and other analogous vegetable substances."—A communication from Augustus H. Tait, Jersey; Hudons, New Jersey; William H. Holbrook, New York; and A. R. Patoo, Brooklyn, Kings, America.

218. George Darlington, Minera, Denbigh, "Improvements in the manufacture of zinc white."

277. Richard Archibald Brooman, Fleet-street, London, "Improvements in the manufacture of glass."—A communication from Mathias Andre Pelletier, Rive de Gier, France.

281. George Hammond, Manchester, and James William Kemp, Salford, Lancashire, "Improvements in the manufacture of illuminating gas, and in apparatus to be employed therein."—Petitions recorded February 2, 1864.

283. Edward Beens, Argyll-street, London, "Improvements in preparing or treating animal charcoal."

Notices to Proceed.

2425. Edward Brown Wilson, Strand, London, "Improvements in the manufacture of iron and other metals, and in the apparatus employed therein, parts of which are applicable for other purposes, where high temperatures are employed, and also for ventilation."—Petition recorded October 3, 1863.

2373. Lucius Henry Norris, Upper Bedford Place, Russell Square, London, "Improvements in the manufacture of India-rubber and gutta-percha compounds."—A communication from Lyman Holme, Rue Vendôme, Paris.—Petition recorded September 26, 1863.

3209. Charles Bolton, Moreton Street, Pimlico, London, "Improvements in apparatus for producing optical illusions, which may be used for dramatic and other entertainments."—Petition recorded December 19, 1863.

58. Bernhard Samuelson, Banbury, Oxford, "An improvement in smelting iron ores."—Petition recorded January 9, 1864.

2374. William Melan, Walpole Street, Deptford, Kent, and William Tice, Downham Road, Islington, London, "Improvements in apparatus for supplying gas to railway-carriages and other moving structures, and in apparatus for manufacturing and holding gas in ships and other vessels, parts of such apparatus being also applicable for manufacturing and holding gas elsewhere."—Petition recorded September 26, 1863.

2383. John Bailey, William Henry Bailey, Salford, Lancashire, and George Henry Blake, Manchester, "Improvements in barometers, gas regulators, and other apparatuses for regulating and indicating the flow and pressure of liquids and fluids."

2699. Samuel Hickling Parkes, Birmingham, Warwickshire, "Improvements in opera glasses, telescopes, microscopes, spectacles, and other optical instruments."—Petition recorded October 31, 1863.

2467. William Lorberg, Wyld's Rents, Bermondsey, Surrey, "Improvements in the manufacture of gas from tar."

2489. Duncan Proudfoot, Glasgow, Lanark, N.B., "Improvements in printing on textile fabrics."

2509. Joseph Place, Hoddlesden, Lancashire, "An improved application of certain schistous or shaley materials to the manufacture and finishing of paper."—Petitions recorded October 13, 1863.

2520. William Jackson Rideout, Farnworth Mills, Bolton, Lancashire, "Improvements in boiling rags and other paper-making materials."—Petitions recorded October 14, 1863.

MISCELLANEOUS.

British Pharmacopœia.—In consequence of the insertion of an abstract of Dr. Redwood's lecture, we omit our article on the Pharmacopœia.

Cavendish Society.—The annual meeting of this Society was held on Tuesday last. We defer any report of the proceedings until the report of the Council is in our hands.

Royal Institution.—Monday, March 7, at two, General Monthly Meeting. Tuesday, March 8, at three, Professor Marshall, "On Animal Life." Thursday, March 10, at three, Professor Marshall "On Animal Life." Friday, March 11, at eight, Rev. W. H. Brookfield "On the Use of Books." Saturday, March 12, at three, Professor Frankland "On the Metallic Elements."

Alkali Act.—The following are the names of gentlemen appointed by the Board of Trade, District Inspectors under the Alkali Works Regulation Act:—

Mr. Brereton Todd,
Mr. Alfred E. Fletcher,
Dr. Charles Blatherwick,
Dr. John Thomas Hobson.

The salary is 400*l*. per annum. Mr. Fletcher, we believe, was a member of the firm Wilson and Fletcher, chemical manufacturers. The names of the other gentlemen are entirely unknown to us.

Young *v.* Fernie.—This is another trial by Mr. Young to establish his exclusive right to the manufacture of paraffine oils and paraffine from bituminous coal. It commenced before Vice-Chancellor Stuart on Monday last. Seven counsel are engaged for the plaintiff, and six for the defendant. There are 200 witnesses to be examined, we are informed; and the trial will probably extend over three weeks. Dr. Hofmann was the first witness, and was under examination three days. We hope to be able to give a brief analysis of the chemical evidence. The issues raised appear to be the same as in the cause of Binney and Co. against the Clydesdale Chemical Company.

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

E. B.—Published by Churchill and Sons.

G. A.—The compound is commonly sold by practical chemists.

Dr. Smith, Auburn, Ohio, U.S., is thanked for his communication, but it is altogether unsuited to our columns.

Books Received.—"A Chart," &c. Churchill and Sons.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*Researches on the Platinum Metals,**

by Wolcott Gibbs, *M.D.*

(Continued from vol. vii., page 98.)

The mass of mixed double chlorides, after the volatilisation of the osmium and the separation of the iron and other impurities by washing with a concentrated and cold solution of chloride of potassium or ammonium, is to be rubbed to fine powder, boiling water added, and the iridium reduced by a dilute solution of nitrite of soda, care being taken not to use more of this salt than is sufficient to convert the iridium salt, $IrCl_2KCl$, into $Ir_2Cl_3 3KCl$, and to keep the solution neutral with carbonate of soda. Almost the whole of the chlorplatinate of potassium remains undissolved, while the iridium, rhodium, and ruthenium soluble salts remain in solution. The liquid is to be allowed to cool, filtered, the remaining mass washed with cold water until only the chloroplatinate of potassium remains, and the washings filtered and added to the main solution. If the washings have been carefully performed with small, successive quantities of water, very little platinum is dissolved, and the olive-green solution contains chiefly—

$$Ir_2Cl_3 3KCl, Rh_2Cl_3 3KCl, Ru_2Cl_3 2KCl,$$

and $RuCl_2KCl$ with insignificant quantities of $PtCl_2KCl$.

A solution of chloride of luteocobalt, $6NH_3 . Co_2Cl_3$, is now to be cautiously added as long as a precipitate is produced; a copious pale buff precipitate is thrown down which settles easily, leaving a yellow or orange-yellow solution containing the luteocobalt salt in small excess. The precipitate is to be washed by decantation, then thrown upon a filter and thoroughly washed with boiling water and afterwards with boiling dilute chlorhydric acid. The filtrate and washings are to be evaporated together on a water-bath to dryness. They contain the whole of the ruthenium and platinum present in the original solution. The mass upon the filter, which has a pale buff colour, consists of the two insoluble double salts—

$$6NH_3 . Co_2Cl_3 + Ir_2Cl_3, \text{ and } 6NH_3 . Co_2Cl_3 + Rh_2Cl_3,$$

and is perfectly free from ruthenium and platinum.

This process is based upon the fact that the iridium and rhodium double salts above mentioned are almost absolutely insoluble in boiling water and in boiling dilute chlorhydric acid, while the ruthenium and platinum salts, which have respectively the formulæ—

$$6NH_3 . Co_2Cl_3 + 3RuCl_2, \text{ and } 6NH_3 . Co_2Cl_3 + 3PtCl_2,$$

are easily soluble.

Palladium also forms with chloride of luteocobalt a double salt which is easily soluble in dilute chlorhydric acid, and which crystallises from the solution, on cooling, in beautiful orange-yellow, granular crystals. The formula of this salt is—$6NH_3 . Co_2Cl_3 + 3PdCl$. Any traces of palladium which may have been present in the original mass of double chlorides will therefore be found with the ruthenium and platinum salts. When the mixed chlorides have been thoroughly washed, palladium is never present. The sesquichloride of ruthenium gives no precipitate with solutions of chloride of luteocobalt, and appears not to form a double salt with the chloride of this radical, possibly in consequence of the triacid character of luteocobalt, and the bibasic character of the sesquichloride of ruthenium, the potassium double salt being $Ru_2Cl_3 + 2KCl$. All the sesquichloride of ruthenium present in the mass of mixed chlorides in combination with chloride of potassium will therefore be found in the filtrate from the insoluble iridium and rhodium double salts.

The mass of double salts of iridium and rhodium with luteocobalt, after complete washing, is to be brought into a flask and boiled with a strong solution of caustic potash until ammonia ceases to be given off. With a concentrated solution this may be effected in a short time. On addition of an excess of chlorhydric acid the black powder readily dissolves, giving a solution which contains the double chlorides of iridium and potassium and rhodium and potassium—$Ir_2Cl_3 3KCl$, and $Rh_2Cl_3 3KCl$, together with chloride of cobalt. The solution is to be evaporated to dryness, and the chloride of cobalt dissolved out by boiling with absolute alcohol. The iridium and rhodium are then to be separated by nitrite of soda and sulphide of sodium or ammonium in the manner already pointed out. The sulphide of rhodium after washing and continued ignition gives pure metallic rhodium.

The filtrate from the iridium and rhodium salts contains a comparatively large quantity of ruthenium in the form of $Ru_2Cl_3 2KCl$ and $RuCl_2KCl$, together with a trace of the ruthenium and platinum double salts—

$$6NH_3 . Co_2Cl_3 + 3RuCl_2 \text{ and } 6NH_3 . Co_2Cl_3 + 3PtCl_2.$$

The solution is to be evaporated nearly to dryness, boiled with a strong solution of caustic potash, and then treated with an excess of chlorhydric acid, which gives the double chlorides—

$$RuCl_2KCl, PtCl_2KCl, \text{ and } Ru_2Cl_3 2KCl,$$

together with an excess of chloride of potassium and a little chloride of cobalt. This last may easily be removed by alcohol after evaporating the mixed chlorides to dryness. Platinum and ruthenium may then be separated by boiling with nitrite of potash, evaporating to dryness, boiling with dilute chlorhydric acid so as to convert the whole of the ruthenium into $RuCl_2KCl$, neutralising with carbonate of potash, again boiling with nitrite of potash, evaporating to dryness and dissolving out the double nitrite of ruthenium and potash by absolute alcohol. The nitrite of ruthenium and potash may then be treated in the manner already described, and the ruthenium brought into the form of the double salt of mercury and ruthendiamin, from which the pure metal is easily obtained. This method of separating the platinum metals gives excellent results, but is not free from objection. In the first place, it will be remarked that it does not dispense with the employment of the alkaline nitrites, although to some extent it facilitates their use. But the chief objection is found in the necessity of employing very large quantities of chloride of luteocobalt, a salt which is not to be had in commerce, and which must therefore be specially prepared for the occasion.

This difficulty may be in a great measure avoided by employing the chloride of luteocobalt chiefly as an agent for the separation of rhodium from platinum and ruthenium, which may be accomplished in the following manner:—The mass of mixed double chlorides, after the removal of the iron, &c., by washing, is to be rubbed to a fine powder in an unglazed porcelain mortar, and then washed with cold water in small portions at a time until the washings give no sensible reaction for ruthenium, when tested in the manner already described with nitrite of potash and colourless sulphide of ammonium. The washings contain all the ruthenium, as—$RuCl_2KCl$ and $Ru_2Cl_3 2KCl$, and all the rhodium, as—$Rh_2Cl_3 3KCl$, together with a not inconsiderable proportion of iridium, as—$IrCl_2KCl$, and a much smaller quantity of platinum, as—$PtCl_2KCl$. The iridium in this solution is to be reduced to sesquichloride by the addition of a dilute solution of nitrite of soda with a little carbonate of soda to keep the solution as nearly neutral as possible. A solution of chloride of luteocobalt is then to be added as long as a precipitate is produced, when the whole is to be filtered and the precipitate thoroughly washed, first with boiling water, and afterwards with water containing a little chlorhydric acid. The precipitate on the filter consists chiefly of the rhodium salt—$6NH_3\ .\ Co_2Cl_3 + Rh_2Cl_3$, with a smaller proportion of the corresponding iridium salt. The mixed rhodium and iridium salts are then to be boiled with a solution of caustic potash as long as ammonia is evolved, treated with excess of chlorhydric acid, evaporated to dryness, the chloride of cobalt dissolved out by alcohol, and the iridium and rhodium separated by nitrite of soda and sulphide of ammonium in the manner already pointed out.

The filtrate from the insoluble rhodium and iridium salts contains the ruthenium as $RuCl_2KCl$ and $Ru_2Cl_3,2KCl$, together usually with a small quantity of the double salt $6NH_3\ .\ Co_2Cl_3 + 3RuCl_2$ and of $PtCl_2KCl$. The platinum and ruthenium are then to be separated with nitrite of potash and alcohol by the process already described. This method of employing the chloride of luteocobalt is extremely convenient when it is desired to obtain pure ruthenium or rhodium at once from the osmium-iridium.

The presence of a portion of the ruthenium in the form of $Ru_2Cl_3,2KCl$ in no wise modifies the application of the above process, because this salt gives no double decomposition with a solution of chloride of luteocobalt. As the nitrite of soda employed to reduce the $IrCl_2$ to Ir_2Cl_3 may exercise a reducing action on the Ru_2Cl_3, it will be found advantageous after washing out the $RuCl_2KCl$ and $Ru_2Cl_3,2KCl$, to convert the $Ru_2Cl_3,2KCl$ entirely into $RuCl_2KCl$. This may easily be accomplished by adding a solution of caustic potash in excess, and then passing a current of chlorine gas into the liquid until the odour of hyperruthenic acid is observed. By adding nitric acid in excess, so as to dissolve the black precipitate at first produced, and then evaporating to dryness with an excess of chlorhydric acid, the whole of the ruthenium will be brought into the form of $RuCl_2KCl$.

When a solution of chloride of luteocobalt is added to one containing bichloride of iridium, an insoluble, buff-coloured precipitate is thrown down, consisting of a salt which has the formula—$6NH_3\ .\ Co_2Cl_3 + 3IrCl_2$. When this salt is digested or boiled with an alkaline nitrite, the bichloride of iridium is reduced to sesquichloride, and the salt, $6NH_3\ .\ Co_2Cl_3 + Ir_2Cl_3$ is formed, well characterised by its extreme insolubility. In the presence of a large excess of platinum in the form of $PtCl_2KCl$, it is very difficult to reduce iridium completely from bichloride to sesquichloride, and even in the presence of an alkaline nitrite the chlorplatinate of potassium, after repeated crystallisation, obstinately retains a reddish or deep orange tint, arising from traces of the corresponding iridium salt. The presence of the smallest trace of iridium may be easily detected in the platinum salt by dissolving the whole in boiling water and adding a solution of chlorplatinate of luteocobalt—

$$6NH_3\ .\ Co_2Cl_3 + 3PtCl_2,$$

which precipitates only its equivalent of the corresponding iridium salt. The precipitate is to be filtered off, and digested with a hot solution of nitrite of soda or potash, a small excess of a solution of chloride of luteocobalt added, and the double chloride $6NH\ .\ Co_2Cl_3 + Ir_2Cl_2$ thoroughly washed. This process affords a perfectly satisfactory method of separating iridium quantitatively from platinum, and for analytical purposes is more convenient than the separation by an alkaline nitrite and sulphide already described. The quantitative separation of iridium from ruthenium and palladium is also readily effected by the chloride of luteocobalt, as well as the separation of rhodium from platinum, ruthenium, and palladium. I shall return to this subject in treating of the metals of this group separately, and will then point out another method of using the chloride of luteocobalt, which is also deserving of attention.

The separation of the metals contained in the mass of sulphides precipitated in the separation of iridium from rhodium, ruthenium, and platinum, by the method already pointed out, may be very conveniently effected in the following manner:—The mixed sulphides are to be dried, separated from the filter, and intimately mixed in a mortar with an equal weight of a mixture of equal parts of carbonate and nitrate of baryta. The filter is to be burned, and the ash mixed with the sulphides and baryta salts. The mixture is then to be ignited in a porcelain or earthen crucible for an hour at a full red heat, and the mass which does not fuse, treated with a strong chlorhydric acid, which dissolves the oxides of rhodium, ruthenium, and platinum completely, leaving only sulphate of baryta. The baryta is then to be precipitated by sulphuric acid, an excess of which must be carefully avoided, and then a solution of chloride of luteocobalt added as long as a precipitate is formed. The double chloride of rhodium and luteocobalt may then be filtered off and thoroughly washed with boiling water acidulated with chlorhydric acid. By igniting this salt and dissolving the chloride of cobalt out from the mass, pure metallic rhodium remains. The platinum and ruthenium in the filtrate may then be separated by means of nitrite of potash and alcohol in the manner already described.

This method of treating the sulphides requires only a small quantity of chloride of luteocobalt, is extremely easy of application, and is much shorter than the first method which I have described. Taken in connexion with the process for separating iridium by means of nitrite of soda and sulphide of sodium, it furnishes an easy and complete solution of the problem of the qualitative or quantitative separation of the metals of this group, osmium only being determined by the loss.—*American Journal of Science.*

(To be continued.)

TECHNICAL CHEMISTRY.

On the Adulteration of Beer with Picrotoxine,
by M. SCHMIDT.

THE attention of the police having been drawn to the importation to St. Petersburgh of large quantities of cocculus indicus, it was found that this berry was used to adulterate certain drinks, but especially beer. Wishing to assure himself of the truth of this statement, M. Schmidt endeavoured to isolate the picrotoxine, and believes he has succeeded by the following rather complicated process:—After evaporating the beer in a water-bath to a syrupy consistence, he mixed it with tepid water till it was perfectly liquid, so as to bring the volume to a third of the liquid used; he then heated and shook it up with animal charcoal. After standing several hours, he filtered, and then heated it slightly, precipitated by basic acetate of lead, and again filtered.

The liquid should be of a yellow wine colour; if not, it must be re-filtered through animal charcoal. Then from five to ten cube centimetres of amylic alcohol are to be added to the liquid, which should be briskly shaken several times at intervals. After twenty-four hours, the amylic alcohol collects on the surface, containing the greater part of the picrotoxine. The remainder is subsequently eliminated by fresh treatment with amylic alcohol. Having collected the limpid layers of this alcohol, they are left to evaporate spontaneously. On the sides of the capsule a yellowish ring forms, and this contains the picrotoxine mixed with resinous substances.

Such is the first phase of the process; the second, and yet more delicate, phase has for its object the isolation of the picrotoxine. The resinous product is first dissolved in weak alcohol, evaporated to dryness, then recovered by a little boiling water containing a small quantity of sulphuric acid, afterwards boiled to expel any volatile matter, then a little animal black is added to eliminate all extractive and resinous matter, and lastly it is filtered. The inodorous liquid is next evaporated, and when a fresh bitter taste becomes developed it is to be shaken up with ether, which re-dissolves the picrotoxine, and collects into a distinct layer on the surface of the liquid. On again treating with ether, the whole of the picrotoxine is eliminated; finally, the etherial liquids are mixed, a little alcohol is added, and the whole is evaporated. The white or yellowish ring formed consists of picrotoxine, which then has only to be dissolved in alcohol to furnish the immediate principle in the form of well-defined crystals.

But to obtain these crystals the solution must be free from resinous substances. If not free, and if, for instance, the etherial solution is of a yellow colour, it must be recovered with water, and treated by charcoal, as above described.

The latter, it is true, retains traces of picrotoxine, which can be taken up by means of diluted and warm spirits of wine.

By these means the author was enabled to detect 0·04 of picrotoxine in a bottle of beer which had been adulterated with eight grains of indian berry.

Picrotoxine has a pronounced bitter flavour; it is in the form of clearly-defined crystals, which form very readily in ordinary alcohol, but not at all in ether or amylic alcohol. If, on the point of a penknife, we take a little picrotoxine, and place it on a highly-coloured plate of glass, then add alcohol to dissolve it, and leave it to evaporate slowly, silky crystals will, after a time, form, and group in tufts; to effect this, the liquid must be sufficiently diluted.

Picrotoxine reduces the oxide of copper in Barreswil's liquid.[*] Heated, it forms a yellow transparent mass, resembling caramel, then it becomes charred. Its reaction is neutral; sulphuric acid becomes yellow while dissolving it, and when hot destroys it. Weak sulphuric acid has no action on it, neither have nitric, tartaric, nor acetic acids, when diluted with water, nor ammonia; very soluble in alcohol, ether, amylic alcohol, and chloroform. Slightly soluble in fatty oils and petroleum; hot water dissolves picrotoxine better than cold; and the best crystals are formed in ordinary alcohol.—*Journal de Pharmacie et de Chemie*, xliii., 170. 63.

Note on Sponge, by R. J. Rutter, *Analytical Chemist.*

When well-washed Turkey sponge is immersed in a nitro-hydrochloric acid bath (nitro-hydrochloric acid, ʒiij.; water, ℥v) for half a minute, then lightly pressed and removed into a sulphuric acid bath (acid sulph. dil., Ph. L., 1851) for fifteen minutes; and then plunged into a solution of ammonia (liq. ammonia ·880, ʒij.; water, ℥j.), and allowed to digest for five or ten minutes, a beautiful orange-yellow colour will be produced, which is very permanent. The texture of the sponge is not at all injured by this process, if it is not digested longer than half a minute in the nitro-hydrochloric acid bath; it wears equally as well as the ordinary sponge, and is much more saleable.

I believe the colour to be due to the action of the acid on the iodine and bromine contained in the sponge. In the first instance, iodine and nitro-hydrobromic acids being produced, the iodine is converted by the sulphuric into iodo-sulphuric acid, and this, in turn, is decomposed by the ammonia, iodine and a small portion of bromine being liberated.

The ammonia bath, after the immersion of the sponge, contains sulphate of ammonia, and also a small portion of nitrate and hydrochlorate.

PHARMACY, TOXICOLOGY, &c.

The British Pharmacopœia.

(*Continued from page 87.*)

Aconitum.—The Galenical preparations of this important plant will be noticed in their proper places. The alkaloid *Aconitia* is the only thing we shall here allude to. In the directions for the preparation of the alkaloid we have the first example of something like a manufacturing process. The Pharmacopœia, in general, deals with grains and ounces, and it is almost startling to read the directions which begin. Take of aconite root, in coarse powder, *fourteen pounds*. The process which follows is altogether unexceptionable. It was, in fact, most liberally placed at the disposal of the Pharmacopœia committee by the eminent makers of this alkaloid, Messrs. Hopkin and Williams; and with careful manipulation yields a perfectly pure aconitine. The process has already been published in our columns, and will be found at page 200, vol. viii.

It is unfortunate that so expensive an article as aconitine cannot be obtained in a crystalline state, so that its purity may be determined by its physical character. It is described in the Pharmacopœia as "a white and usually amorphous solid," which will also accurately describe the worthless and almost inert aconitine imported from Germany, against which we may once more caution our readers.

Aconitine is very seldom seen perfectly white, but is usually of a light-brown colour. A loss is sustained by repeated solution and treatment with animal charcoal, which is a matter of some consequence to the manufacturer.

Aconite root deserves more attention than it has yet received from chemists and pharmaceutists. The nature and properties of the resinous matter soluble in alcohol, but not in ether, which is separated in the above process, have not yet, so far as we know, been investigated, and might well repay examination.

Æther.—The London College, in 1851, gave no directions for the manufacture. In the British Pharmacopœia, the process of the Edinburgh College has been adopted, and an ether differing slightly from that described in 1851 is directed to be made. It is completely dehydrated, but may contain about 8 per cent. by volume of alcohol. The density is now ·735 instead of ·750.

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[*] On this reaction the author founds a process for distinguishing picrotoxine from alkaloids. However, the basis of this process is wrong, if it be true, as M. Kosmann affirms, that alkaloids are themselves glucosides.

We shall pass over Spirit of Nitrous Ether for the present, having some experiments on the subject to complete. By *Alumen* the Pharmacopœia intends the double sulphate of alumina and potash, which we fear will seldom be obtained. Practically, this is of very little importance. If, in making alumen exsiccatum, care be taken to carry the heat only so far as is necessary to get rid of the water of crystallisation, the resulting "burnt alum" will be much the same thing in both ammonia and potash alum; but if the heat is carried much further with ammonia alum, the sulphate of ammonia decomposes and is lost, and a residue of sulphate of alumina only remains.

Liquor Ammoniæ Acetatis.—This solution is now directed to be made by neutralising the strong solution of ammonia with acetic acid, and is, moreover, a much stronger solution than was ordered in preceding Pharmacopœias. It is difficult to guess the reason for the change, unless the object of the Committee was to imitate more closely the original Spirit of Mindererus, which was made by neutralising strong vinegar with real Spirit of Hartshorn, and must have been a nasty compound. However that may be, the liquor ammoniæ acetatis of the British Pharmacopœia will differ essentially from that of the London, Dublin, and Edinburgh Pharmacopœias. It is five times stronger than the London preparation, and six times stronger than the Dublin and Edinburgh. Perhaps the reason for making it by means of a solution of ammonia instead of the sesquicarbonate was a supposed difficulty in ascertaining the exact point of saturation, in consequence of the carbonic acid. The new medicine, though probably as efficacious as the old, will be a vapid, tasteless liquor, very different to the bright, sparkling fluid, when freshly prepared, obtained in the old way.

This is one of the preparations which will give pharmaceutists some trouble with prescriptions. Nobody is likely to be poisoned if the new liquor is put when the old is intended, nor is much injury likely to accrue from the reverse substitution. Dispensers, however, are bound to consult the wishes of prescribers, and will in general be guided by the dose ordered, which they may expect to be about one-fifth of what was formerly prescribed under the same name.

Ammoniæ Benzoas.—The Pharmacopœia directions for the preparation of this salt may be followed with safety. An excess of ammonia is ordered, but it will be well to add a small quantity occasionally as the evaporation proceeds to prevent the formation of the less soluble acid salt. The crystals must be dried at a very low temperature, since the normal benzoate is so easily converted into the acid salt.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 3, 1864.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

The minutes of the previous meeting having been read and confirmed, and the several donations to the Society's library acknowledged by a vote of thanks, Mr. Benjamin E. R. Newlands was admitted a Fellow of the Society, and Mr. Edward Baines, of Toronto, Canada West, and Mr. William Ritchie, jun., were duly elected by ballot.

The President, in announcing the programme relative to the changes in the Council which would be proposed for adoption at the anniversary meeting on the 30th instant, mentioned the name of Mr. C. Greville Williams in substitution for Mr. Way, the other members of the Council remaining as already enumerated in our last report. The President took occasion, also, to mention that the researches on the formation of malonic and succinic acids, which, at the period of the Society's last meeting, were being pursued independently by Professor Kolbe and Dr. Hugo Müller, were now to be proceeded with by these gentlemen conjointly.

An interesting paper, "*On the Non-Metallic Impurities of Refined Copper,*" was read by Professor F. A. Abel. The author commenced by referring to the experiments which had already been made by Berthier and Karsten, and more recently by Percy, Dick, and Matthiessen, for the purpose of determining the influence of various impurities upon the working qualities of copper. It was manifest that the *metallic* impurities always exerted a considerable influence, and now that the system of analysis had been so far perfected as to show the smallest traces of the commonly occurring metals, and to indicate their amount, there appeared but little room for improvement to be effected in this branch of the analytical examination. Some account of the metals usually found occurring in the commercial qualities of copper had been given in a paper recently presented to the Society by the author, in conjunction with Mr. F. Field. The primary object of the present communication was to arrive, if possible, at a more accurate conclusion regarding the existence and amount of the several *non-metallic elements* which occurred, or were liable to be found, in the various qualities of refined copper met with in commerce, and the experiments described were directed especially to the quantitative estimation of oxygen and sulphur. Many samples of ingot copper from Swansea, and other specimens prepared for the purposes of this investigation from chemically pure copper, were examined.

Determination of the Amount of Oxygen in Copper.—This constituent is so generally present, and is known to exert so marked an influence upon the quality of the copper that it became extremely important to examine critically the processes by which the amount of this element in any given sample has usually been determined. The oxidisable nature of copper at high temperatures, and the known fact of suboxide of copper being soluble to a considerable extent in the fused metal, made it almost impossible that samples resulting from the ordinary metallurgical treatment should be free from oxygen; and the investigation was, therefore, commenced at this point. The method which had been usually followed in determining the amount of oxygen was that of heating the finely-divided metal in a current of pure and dry hydrogen, and collecting in a weighed chloride of calcium tube the whole of the water formed. This process was used by Dick in his interesting researches made in 1856; but the difficulties were at that time allowed to be such as to introduce the chance of error, and the results were no doubt in excess of the true amount, and were seldom concordant in the different operations made upon the same sample. Another process was that of determining the loss of weight sustained by melting the copper under charcoal and in an atmosphere of pure hydrogen; whilst a third suggestion was that of converting the copper into protoxide in the wet way, and then comparing the amount of copper deduced from the weight of the oxide obtained with that of the metal originally dissolved. Neither of these processes were considered by Dick as affording more than approximative results; and the last was far from being satisfactory. Mr. Abel had instituted a very complete series of experiments for the purpose of ascertaining the degree of reliance which might be place in the method of reduction by hydrogen; but it was found to be altogether untrustworthy, chiefly from the circumstance that it was impossible to exclude air from the apparatus, or to drive out that portion which ordinarily occupies the cavities in the metal assayed; whilst, on the other hand, it was found that but little dependence could be placed on the total expulsion as water of the whole of the oxygen contained in the metal operated upon. The current of hydrogen gas, after passing over heated copper wire in a preliminary tube, and thence through efficient drying arrangements, was passed, in some instances, for fifteen and even twenty hours through the apparatus before the tube containing the copper to be experimented upon was heated; and every precaution was taken in properly securing the important joints of the chloride of calcium or phosphoric acid tube, and the glass combustion tube in which the sample of copper under analysis was contained. Still no reliable results could be obtained in this manner. Much better success was, however, obtained by using a process which the author next proceeded to describe. It is well known that pure copper decomposes neutral nitrate of silver with formation of an equivalent amount of nitrate of copper, the silver being deposited; but if suboxide of copper be contained in the sample of metal operated upon, a secondary reaction will take place, resulting in the production of an insoluble basic nitrate of copper. Therefore, when copper is converted into nitrate by means of the neutral silver-salt, any suboxide which it may contain is converted by one equivalent of nitrate of silver into two equivalents of protoxide; the excess of base thus presented to the nitric acid induces the formation of an insoluble basic salt of copper, and the basicity of the total amount of this product obtained in the reaction is directly proportionate to the quantity of suboxide contained in the sample of metal under examination; and consequently the volume of acid required to neutralise such basic salt of copper will at once indicate the amount of oxygen existing in the original specimen. In applying these facts to the determination of oxygen in copper, it is simply necessary to convert a known weight of the metal into nitrate by digesting in an aqueous solution of neutral nitrate of silver, then to collect the mixed particles of reduced silver and basic nitrate of copper, wash them on a filter, and digest them for about half an hour in the cold with a known volume of standard sulphuric acid (one part of oil of vitriol diluted with about one hundred parts of water) until the whole of the copper salt has been dissolved. In order now to determine the proportion of acid which has become neutralised in this operation, a standard solution of carbonate of soda (containing 930 grains of the dry salt dissolved in a gallon of water) is added until a precipitate of carbonate or, rather, basic sulphate of copper begins to appear. Calculation gives at once, from the amount of acid which has been neutralised by the act of dissolving the basic nitrate of copper, the proportion of oxygen, or suboxide, contained in the original sample of copper. The author stated that it was not necessary to wait for the entire solution of the specimen operated upon, but that as soon as 100 grains, or about that quantity, had been dissolved away by the action of the nitrate of silver, the remaining portion of metal could be removed from the solution, and its loss of weight noted. Several determinations were made in succession upon the same lump of copper, and the results showed a close agreement in every case, but it was occasionally remarked that the top of an ingot contained somewhat more oxygen than the lower portions, this difference increasing with the amount of oxide contained in the specimen. In the examination of a series of ingots of Kapunda copper, it was invariably found that the physical structure of the metal was to some extent influenced by the oxygen contained therein, and particularly it was noticed that ingots which exhibited depressions along the centre of their upper surfaces contained more oxygen than others which appeared to be flat. This brand of copper had been selected on account of its general purity and freedom, especially from extraneous metals. The amount of oxygen in the ingots was found to vary between the limits of ·12 and ·33 per cent. By prolonged fusion of ordinary copper in a closed crucible, under a layer of charcoal, and allowing the mass of metal to cool out of contact with air, Mr. Abel had succeeded in preparing samples of copper which were entirely free from oxygen, and, tested by the analytical method already described, gave nothing but pure reduced silver. The physical characters of such copper were great toughness, combined with highly crystalline structure, and showing cavities of contraction upon the upper surface, which was always remarkably brilliant. But if the same metal were removed from the furnace and cooled with free exposure to air, the structure became highly vesicular, and excrescences were formed upon the upper surfaces. In proceeding to describe the results obtained in the analysis of a series of samples in different stages of manufacture, which were supplied by the Hafod Works, near Swansea, Mr. Abel gave the following numbers as representing the average proportion of oxygen contained in these ingots:—

	Oxygen per Cent.
"Dry" copper	0·42
Do. (another specimen) .	0·50
"Half-poled" copper . . .	0·20
"Tough pitch" copper . . .	0·03
"Overpoled" copper. . . .	0·03

The coincidence observed in the proportion of oxygen contained in the last two kinds of copper led to the institution of several experiments, in order to confirm their accuracy. It appears, however, probable that copper in the overpoled condition cannot be cast in air without absorbing a small amount of oxygen. Again, with regard to the amount obtained in the analysis of "dry" copper, it was observed that the maximum fell considerably short of that mentioned in the publications of Percy and Dick. The author had consequently been led to make further experiments bearing directly on this point; and by fusing copper in contact with air, or projecting black oxide of copper into the crucible containing the melted metal, it was considered that samples of dry copper perfectly saturated with oxygen were obtained. These gave on analysis amounts practically identical with those already mentioned. (Mr. Abel described his results, not only calculated for the amount of oxygen, but also as being equivalent to the very much larger amount of suboxide of copper, which was stated in all cases. Thus, the 0·5 per cent. of oxygen, observed in the case of dry copper, corresponds to nearly 4·5 per cent. of suboxide of copper. This amount was stated to be lower by one-half than the results arrived at by A. Dick in estimating the proportion of suboxide by the method of reduction in a current of hydrogen.) With regard to the existence of carbon in commercial samples of copper, Mr. Abel described the attempts he had made to detect the presence of this element, and to combine directly carbon and copper. There was no evidence, however, of any combination being formed even when melted copper was kept for a long time in contact with wood charcoal. One of the methods adopted in searching for carbon in copper consisted in acting upon the metal with nitrate of silver, and treating the reduced silver with mercury. Alten and Kapunda copper were used in these trials, it being important to exclude the presence of foreign metals. In the course of making the experiments connected with the identification of carbon in Alten copper, it was discovered incidentally that this kind of copper contained a trace of selenium. This element was detected in the sublimate formed on heating a small quantity of black insoluble residue, which was left on dissolving the metal in perchloride of iron. The method ultimately adopted for its detection was that of adding a little carbonate of soda to the nitric acid solution of 1000 grains of the copper; the whole of the selenium was carried down in this first portion of precipitate, and could be separated by dissolving in hydrochloric acid and boiling with sulphurous acid. The utmost amount of selenium obtained did not exceed ·003 per cent. There was no doubt that sulphur and oxygen co-existed in samples of refined copper; and when experiments were made for the purpose of determining the amount of the latter by reduction with hydrogen, a small quantity of the sulphuretted compound of that element was invariably produced. The separation of the whole of the sulphur in this manner was attended with difficulty, for even when the metal was employed in the state of filings a long time was required for the complete elimination of this constituent. Not more than ·005 per cent. of sulphur was detected in a sample of copper heated for forty-eight hours in a current of hydrogen, the products being in this case collected in the form of sulphide of lead. Phosphorus and nitrogen had been looked for, but neither of these elements had ever been detected. The mode of examination consisted in partially precipitating the nitric solution of the copper with carbonate of soda, as in the case of selenium, then decomposing the precipitate by sulphuretted hydrogen, and looking for phosphoric acid in solution by the ordinary tests. The metal was digested in a mixture of sulphuric acid and bichromate of potassa, with the view of searching for nitrogen, which it was believed would have been eliminated as gas. None was given off. The author alluded to the occasional existence in copper of small portions of enclosed slag, but, excepting in this form, there was no reason to expect the existence of silicon as an impurity, and in the course of his experiments none had ever been found. The lecturer took occasion to acknowledge the assistance he had received during the prosecution of these researches from Mr. E. O. Brown and Mr. F. H. Hobler, both of whom had contributed very materially to the elaboration of the analytical details.

The discussion which followed the reading of the above paper, and the report of Dr. Frankland's communication "*On the Synthesis of Leucic Acid*," will be given in our next. The President, in adjourning the meeting until the 17th inst., stated that a special lecture, "*On the Organic Peroxides Theoretically Considered*," would then be delivered by Sir Benjamin C. Brodie, F.R.S.

PHARMACEUTICAL SOCIETY.

Wednesday, March 2.

Mr. Sandford, *President, in the Chair.*

Mr. J. Robbins read a paper on "*Oxygennesis, for the Instantaneous Production of Pure Oxygen without Heat.*" From the time of the discovery of oxygen to the present, perhaps no subject has so much engaged the attention of chemists as the production of it at a cost sufficiently low to be employed in the arts, for the reduction of metals and other operations requiring a high temperature, and also for the purposes of illumination, the light obtained by it vieing in splendour with the sun's rays. This desirable object has yet to be accomplished, and may be regarded as a prize to be won by some future happy discoverer. It seems surprising, since Nature has provided us so bountifully with this substance, and presented it in such a variety of combinations, that, up to the present time, there should be no known method of separating, except at such a cost which excludes it for the purposes just enumerated.

In Gmelin's "Chemistry" six processes are given for the production of oxygen:—

1st. By heating chlorate of potash to low redness. As this process is slow and tedious, a small quantity of oxide manganese is usually mixed with the salt, which greatly facilitates the decomposition, and the evolution of gas is both rapid and abundant. According to the authority just named, manganese is often mixed with carbonaceous matter, which passes over as carbonic acid, but another impurity I may mention is the presence of chlorine, which, I believe, may always be detected when oxygen is obtained by this method.

2nd. By ignition of red oxide mercury. The presence of hyponitric acid may be feared in oxygen so obtained.

3rd. By strong ignition of oxide manganese.

4th. By heating manganese with an equal weight of oil of vitriol.

5th. By ignition of nitrate of potash. This salt when heated above its melting point is converted by the loss of two equivalents of oxygen into nitrite of potash; on a further increase of temperature both nitrogen and oxygen pass off, consequently the product is always contaminated with nitrogen, which increases as the action proceeds.

6th. By the action of sulphuric acid on bichromate of potash. Three parts bichromate potash and four parts sulphuric acid are heated together in a capacious retort. An evolution of oxygen gas easy to regulate is the result. In this experiment we might congratulate ourselves if the process is conducted to the end without a fracture of the retort.

Of the six processes just described, two only are now used—viz., chlorate of potash with or without manganese, and manganese alone. More recently other processes have been recommended, one of which, by heating together nitrate of soda and oxide of zinc, has been patented. From this mixture oxygen is said to be produced at a cheaper rate than by any other method at present known. Unfortunately for the value of this discovery the product is contaminated with a considerable per-centage of nitrogen. M. Kuhlman, of Lille, discovered and published an ingenious and beautiful process for the production of oxygen by means of baryta. He found that by passing a current of common air through caustic baryta heated to dull redness, peroxide of barium was formed, which, on an increase of temperature, is resolved into oxygen gas and caustic baryta; the latter ready again to perform its part in a similar operation. The idea naturally suggested itself that the means were now at hand for getting oxygen from the atmosphere in any quantity at a small cost. This method, although so promising, has been for the present abandoned; it was found that after a few operations, either from a molecular change, or from the silica or other impurities, a sort of glass or fusion resulted on the surface, the baryta then refusing to act again.

We now come to the consideration of the new method for the generation of oxygen recently introduced by myself. The process or the compound employed in it has been named *oxygennesis*. It will have doubtless been observed by you that in all the processes hitherto known a high temperature is necessary, and until that point is reached, no product whatever is obtained; this fact we may consider as the chief difficulty experienced in the preparation of oxygen, and more especially so when sulphuric acid is used. If, for example, by the mere addition of sulphuric acid to bichromate of potash in the cold, we could get the same results which are obtained by the application of heat, this process, instead of being thrust in the rear, would have taken front rank.

Oxygennesis, therefore, stands alone as a novel and the only mode we possess for producing oxygen without the application of heat. The mode of using this compound is extremely simple. We have only to take some of this powder, place it in a glass flask or bottle provided with an exit tube, pour on any of the dilute mineral acids, and we have immediately oxygen evolved in a similar way, and with as much facility, as hydrogen is obtained from zinc or carbonic acid from a carbonate.

The composition of this compound is extremely simple, merely peroxide of barium, and bichromate potash. Not so the chemical changes resulting from the addition of an acid. Peroxide of barium on addition of sulphuric acid, is resolved into sulphate of baryta and peroxide of hydrogen, and it is from this sometimes so-called oxygenated water we get this curious and interesting chemical reaction. Whenever peroxide of hydrogen and chromic acid are brought in contact with each other, instantaneous decomposition is the result, the chromic acid is reduced to sequioxide of chromium, and the peroxide of hydrogen to water; at the same time pure oxygen derived from both those substances is disengaged. The theory of this very interesting reaction is not, I believe, well understood, and I know only one way of explaining it, that is, on the ozone and antozone theory of Brodie. According to that theory, oxygen exists in three different states or conditions, viz., ozone, antozone, and ordinary oxygen, and whenever ozone and antozone (which may both be considered more or less active) are brought together, they unite and neutralise each other, as it were forming passive or common oxygen.

To return to the composition of the powder, we are not compelled to use precisely those ingredients mentioned, but may substitute analagous compounds. Peroxide of barium might be replaced by any other peroxide capable of forming binoxide of hydrogen, of which there are several—peroxides potassium, sodium, strontium, and calcium, but all these at the present time are practically useless, peroxide of barium being the only one that can be easily and cheaply prepared. Bichromate of potash may be substituted by manganate or permanganate of potash, binoxide of manganese or binoxide of lead; the cost of the two first-mentioned forbids their present use, and the one selected is by far preferable to the others. With regard to the acids, either of the mineral class will do, but I prefer a mixture of dilute sulphuric and hydrochloric acids.

The next question demanding our notice is, in a commercial point of view, a most important one; however much this method may be admired for its simplicity, and the ease with which the operation may be conducted, its ultimate success or failure must depend on its cost. Can the oxygennesis, therefore, be manufactured and sold at a price sufficiently low to make it an article of commerce? I believe it can be, and be made available for all purposes wherever oxygen is required to the extent of some gallons. One of the ingredients of this compound, peroxide of barium, has never yet been produced and sold as a commercial article, and from the trouble of making a small quantity, but few even practical chemists care to prepare it for themselves. It can hardly, therefore, be expected that a compound of this nature can at once be manufactured and sold at a price it must ultimately be reduced to, if extensively used and produced in quantity. 5s. per pound, the price hitherto charged, would, I admit, be a barrier to its general adoption; but I am happy to say we have now made the necessary arrangements to lessen the cost of production, and have at the same time reduced the price.

Some of the baryta compounds are found abundantly in nature, and are but of small value in the market, but up to the present time but few uses have been made of them; they now promise a much more extensive application. Mr. Kuhlman has, perhaps, done more than any one else to develope their uses and value in the arts, and in the Chemical News, November 28, 1863, will be found some interesting extracts relating to them from Dr. Hofmann's report on chemical products and processes of the International Exhibition.

I shall trespass a little further on your time to make a few remarks on one of the various applications of oxygen, which may be of some interest to the medical profession and to pharmaceutical chemists. I mean the employment of that body as a therapeutic agent by inhalation. For that purpose this ready method for producing the gas promises to be of great value. Towards the end of the last and the beginning of the present century, vital air, as oxygen was often and not inappropriately called, was used largely in this country and on the Continent. In this country we find the names of Drs. Beddoes, Hill, Thornton, and other physicians. Dr. Hill used it for more than twenty-five years, and Dr. Thornton was quite eminent for his successful application of it. At the present time the desire by medical men for the administration of oxygen has revived both here and abroad. Two papers have recently been read, to be followed by others on the same subject, before the Academy of Sciences at Paris, by Messrs. Demarquay and Leconte. The experiments and observations of those gentlemen appear to have been very numerous and carefully made both on animals and on man, in disease and in health, and the conclusion they arrive at is that oxygen is a valuable curative agent. If so good, then, as a remedy when its value was once known, what caused it to become and continue so long neglected? The explanation is, I think, not difficult. In the first place, when this body was discovered, too much was expected from it. The first *furore* for its employment arose from the simple experiment which showed its power of rekindling an expiring match, and as oxygen is the essential element of our existence, it was supposed it might, in a similar way, rekindle the expiring vital spark. The more imaginative were elated at what they considered a discovery, so long dreamt of and so earnestly sought after by the alchemist. But oxygen is not the elixir vitæ. It will not restore grey hair to its original colour, nor make an old man young. The difficulties and expense attending its administration may also be considered other reasons for its non-employment. Of what use was it for a medical man to order that which the patient could not get supplied? A physician, therefore, having faith in the remedy, was compelled to lay himself out especially for it, become an oxygen doctor, and prepare and administer the remedy himself. These difficulties now no longer exist.

We have on the table an oxygen inhaler and generator, made according to the suggestions of Dr. Richardson. The generation of the gas is by this method so easy and so simple that patients can prepare their own dose, or, if need be, the nurse after one lesson can as well undertake the operation as any other duty she may be required to perform.

Physicians who may wish to employ this remedy may now prescribe it with no more hesitation than they would prescribe a black draught or a calomel pill.

Dr. Squire wished to inquire whether Mr. Robbins' invention had not been patented; if so, he doubted the value of the patent, for Professor Brodie had pointed out in 1851, that when peroxide of barium was treated with an acid solution of bichromate of potash oxygen was evolved with great regularity. Faraday had mentioned the same thing in one of his lectures on ozone at the Royal Institution. Dr. Squire also objected to the name oxygennesis, and thought it ought rather to be called oxyexodus, as the oxygen was eliminated, not created.

Mr. C. H. Wood said that the reactions of peroxide of barium, and bichromate or permanganate of potash were well known as scientific facts, but did not consider that that affected the value of Mr. Robbins' patent. The great objection to Mr. Robbins' process was the cost of the oxygen, and he was glad to hear that this was likely to be reduced. He did not consider that the process was easier than that for obtaining oxygen from chlorate of potash and manganese; indeed, he thought the latter the easier operation. He wished to know how Mr. Robbins decided that oxygen from chlorate of potash and manganese was contaminated with chlorine, and not by ozone. The late Mr. Witt had shown that oxygen obtained in this way always contained a variable proportion of ozone. He (Mr. Wood) did not consider ozone objectionable for inhalation, for he thought that whatever good was effected by oxygen when inhaled, must be due to the ozone which gave active properties to oxygen.

Professor Redwood said that Mr. Crace Calvert had pointed out that oxygen from chlorate of potash and peroxide of manganese always contained chlorine or an oxide of it, and he did not think that the gas from this source was fit to administer. He freely gave his testimony to the value of the process Mr. Robbins had introduced. The process was certainly easy, though it was not calculated for chemists, but would answer well when oxygen was wanted for medical purposes.

Mr. ROBBINS, in reply, said that he was not aware of Mr. Brodie's experiments, and had not heard of them, although he had spoken to many chemists on the subject. He considered it a great boon to be able to get oxygen by a cold process, and, at all events, still considered the application new. Authorities differed as to the value of oxygen as a curative agent, but the most recent experiments of Demarquay and Leconte seemed to prove that it possessed great remedial power. Under these circumstances it was well to have a means of procuring oxygen as easily as making a cup of tea. With regard to Mr. Wood's doubt about the presence of ozone instead of chlorine, he might say that, in conjunction with Mr. Brown, now of the War Department, he had examined many specimens of oxygen obtained from the chlorate and manganese for ozone, but in all cases found chlorine instead. In his (Mr. Robbins') process the oxygen was well washed.

Mr. WOOD said that washing would not remove ozone.

Mr. ROBBINS replied that Faraday had showed that ozone could be removed by washing, and he himself had found ozone made by means of phosphorus in the ordinary way disappear after shaking with water well for an hour.

The CHAIRMAN said he considered Mr. Robbins' an elegant way of procuring oxygen for medical purposes, which had the recommendation of cheapness when the oxygen was considered as medicine.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 9, 1864.

E. W. BINNEY, *F.R.S., F.G.S., President, in the Chair.*

GEORGE HARRIS, Esq., Barrister-at-Law, was elected an ordinary member.

Professor ROSCOE exhibited the light emitted by burning a portion of a fine specimen of pure magnesium wire 1 mm. in diameter and 10 feet long, which had been manufactured by Mr. Sondstadt. Professor Roscoe remarked that it afforded him great pleasure to be able to state that a suggestion made by Professor Bunsen and himself in their photochemical researches, and printed in the *Philosophical Transactions* for 1859, page 922, was about to be practically adopted. Mr. Sondstadt is now commencing to manufacture the metal magnesium on the large scale, and the first important application of the metal is the employment of burning magnesium wire as an illuminating agent, especially for photographic purposes. In the researches above mentioned, Professor Bunsen and the speaker had examined the photochemical action of the sun compared with that of a terrestrial source of light, and for the purpose of this comparison they chose the light evolved by the combustion of magnesium wire. They showed that a burning surface of magnesium wire which, seen from a point at the sea's level, has an apparent magnitude equal to that of the sun, effects on that point the same chemical action as the sun would do when shining from a cloudless sky at a height of 9° 53′ above the horizon. On comparing the chemical with the visible brightness of these two sources of light it was found that the brightness of the sun's disc as measured by the eye when the sun's zenith distance was 67° 22′, is 524·7 times as great as that of the burning magnesium wire; whilst, at the same zenith-distance, the chemical brightness of the sun is only 36·6 times as great. Hence the value of this light as a source of the chemically active rays for photographic purposes becomes at once apparent. The extract from the memoir referred to is as follows:—"The steady and equable light evolved by magnesium wire burning in the air, and the immense chemical action thus produced, render this source of light valuable as a simple means of obtaining a given amount of illumination expressed in terms of our measurement of light. . . . The combustion of magnesium constitutes so definite and simple a source of light for the purpose of photochemical measurement, that the wide distribution of this metal becomes desirable. The application of this metal as a source of light may even become of technical importance. A burning magnesium wire of the thickness 0·297 millimetre evolves, according to a measurement we have made, as much light as seventy-four stearine candles of which five go to the pound. If this light lasted one minute, 0·987 metre of wire, weighing 0·1204 grm., would be burnt. In order to produce a light equal to seventy-four candles burning for ten hours, whereby about 20 lbs. of stearine is consumed, 72·2 grms. of magnesium would be required. The magnesium wire can be easily prepared by forcing out the metal from a heated steel press having a fine opening at bottom; this wire might be rolled up in coils on a spindle, which could be made to revolve by clockwork, and thus the end of the wire, guided by passing through a groove or between rollers, could be continually pushed forward into a gas or spirit-lamp flame in which it would burn." Professor Roscoe stated that great credit was due to Mr. Sondstadt for the able manner in which he had brought the difficult subject of the metallurgy of magnesium into the present satisfactory position, and expressed his opinion that, even for photographic purposes, the application of the metal will prove most important. Mr. Brothers, Mr. Parry, and other photographers present, corroborated Dr. Roscoe's opinion respecting the value of such a source of light for photography. Since the meeting Mr. Brothers made an experiment upon the magnesium light, which he reports as follows:—"The result of an experiment I have just tried is, that in fifty seconds with the magnesium light I have obtained a good negative copy of an engraving—the copy being made in a darkened room. Another copy was made in the usual way in daylight, and in fifty seconds the result was about equal to the negative taken by the artificial light. The sun was shining, but there was a good deal of fog in the atmosphere."

A paper was read, entitled "*On the Tensile Strength of Cotton, as affected by various Chemical Treatments,*" by Mr. CHARLES O'NEILL, F.C.S. The author has given a great number of experiments upon the subject, made in order to elucidate some important practical and scientific points not hitherto much worked upon. By means of his apparatus for testing tensile strengths (*Proceedings* of this Society, No. 6, 1863-64, p. 186) he was enabled to obtain data which by any previously-known method could only have been obtained, if at all, by an incredible amount of labour.

Effect of Bleaching upon Strength of Cotton.—These experiments were made upon printing cloth of eighteen threads to the quarter inch, American cotton, and bleached for printing by the low pressure process. The process included, among other treatments,—(1) Passing three times over a red-hot copper plate; (2) boiling sixteen hours with milk of lime; (3) boiling sixteen hours with soda and resin; (4) steeping in solution of bleaching-powder for several hours; (5) steeping in dilute hydrochloric acid for several hours.

	Warp.	Weft.
Strength of threads in the grey cloth S.V. (mean of thirty experiments)	3140 grs.	1714 grs.
Ditto in the bleached cloth S.V. (mean of thirty experiments) .	2920 grs.	2785 grs.

The warp threads from two other pieces of cloth give as follow, being the means of forty experiments:—

	A.	B.
In the grey state	3407 grs.	3512 grs.
In the bleached state . . .	3708 grs.	4025 grs.

The cloth S.V. became elongated in the bleaching process, and contracted in width. The contraction in width, owing to the fulling up of the weft, will explain the increase of its strength, while the elongation may explain the diminution of strength in the warp. The cloth A., and also B., were chemically treated exactly as S.V., but were washed and dried loose, and not being fulled so much by the mechanical processes did not sensibly alter in length. The increased strength may be explained by the complete bedding of the cotton hairs, so forming a more compact thread. At any rate, it seems proved that the strength of cotton is not injured by the ordinary process of bleaching for printing.

Effect of Printing, Dyeing, Soaping, &c.—A portion of S.V. was printed dyed, and finished as a first-class madder purple, and twenty experiments made upon the warp and weft threads, with the following results:—

Strength of printed and finished warp	3569
Ditto of printed and finished weft	2669

Here it is seen the warp threads have gained more than they lost in bleaching, while the weft threads have lost something. The increase of strength in the warp threads is partly, if not wholly, explained by the diminution of length, the two yards gained in bleaching, and rather more, being absorbed in the processes of dyeing, soaping, &c., and the thread consequently becomes thicker and stronger.

Mordanted Cloth Treated with Acid.—These experiments are interesting, as touching upon the chemical *versus* the physical theory of dyeing. A piece of calico was chosen printed by blocks in wide longitudinal stripes, with the usual mordants for madder or garancine dyeing; it was aged, cleared, &c., as usual, to remove all loose mordant. Portions containing mordanted and unmordanted parts were treated by hydrochloric acid to remove the mordants, then carefully washed, and the strength of the threads tested. The results are as follow:—

Iron mordant for black, warp threads, ten experiments	3450 grs.
Warp threads contiguous to the mordanted threads, ten experiments	3715 ,,
Same mordant, weft threads, six experiments	2201 ,,
Same weft threads in the unmordanted parts, six experiments	2906 ,,

The above experiments show a decided diminution of strength in those threads which had received the mordant. The unmordanted threads had, of course, been submitted to the same acid and other treatments. A repetition of these experiments upon another piece of cloth of different origin, but similarly printed, and which had been dyed in madder and then treated with hydrochloric acid, gave the following results:—

Alumina mordant for red, warp threads, ten experiments	1906 grs.
Unmordanted threads, contiguous, ten experiments	2031 ,,

showing a diminution of strength.

Iron mordant for black, warp threads, ten experiments	1631 ,,
Unmordanted threads, contiguous, ten experiments	2260 ,,

showing a considerable diminution of strength.

Experiments on Cotton Hairs, taken from Mordanted and Unmordanted Threads, which had been Treated by Acid.

Alumina mordant for red, eight experiments	60·3 grs.
Not mordanted adjacent hairs, five experiments	71·6 ,,

The uncertainty as to whether the mordant had actually touched the hairs in the centre of the threads caused these experiments to be discontinued, and the following instituted:—

Cotton Mordanted in the Wool.—Small parcels of New Orleans cotton were steeped separately in ordinary iron liquor (crude pyrolignate of iron) and red liquor (crude acetate of alumina), saturated with these liquors, the excess expressed out, and then dried gently, and aged for twenty-four hours; afterwards well washed in lukewarm water and dried. A portion of each parcel was then treated with dilute hydrochloric acid, some of the original stock of New Orleans cotton being placed in the same acid, and going through the same treatments. The mordants being dissolved out, the cotton was well washed to free it from the acid, dried, and its strength ascertained with the following results:—

New Orleans cotton not mordanted, ten experiments	143·9 grs.
Ditto mordanted with iron, ten experiments	96·8 ,,
Ditto mordanted with alumina, ten experiments	94·1 ,,

A very notable diminution of strength has occurred in the mordanted parcels.

Gun Cotton.—The only undeniable chemical compound which cotton forms with other elements without undergoing conspicuous physical change is in gun cotton. A sample of New Orleans was treated with equal volumes of concentrated sulphuric and nitric acids. It increased in weight 66 per cent., burned well, and was soluble in alcoholised ether. Twenty hairs being measured gave a mean length of 0·997 inch; twenty hairs before treating gave a mean length of 0·996 inch. The difference (0·001) being within the range of error, it may be said not to have changed in length. The strength of ten hairs was taken, and gave a mean of 85·4 grains. The mean strength of nineteen hairs before treatment being 138·1, there has been a considerable diminution of strength. This may not be true of all kinds of gun cotton.

Mercerised Cotton.—It is very well known that cotton cloth treated with concentrated solution of caustic soda shrinks in length and becomes stronger. The following experiments corroborate this:—New Orleans cotton was treated with soda solution sp. gr. 1·250. Twenty hairs being measured gave a mean length of 0·857 inch, being a contraction of 0·139 inch on the mean of twenty hairs measured before treatment. The mean strength of ten hairs is 154·1 grains against a mean strength of 138·1 grains before treatment. The reliability of these results is discussed by the author. The experiments in detail show wide discrepancies, and the maximum and minimum of a series are often at a considerable distance from the mean. This is a difficulty inherent to the subject, and can only be overcome or lessened by multiplying the experiments. Ten experiments seem to give a reliable mean, for in making twenty or thirty the first, second, and third tens give nearly the same mean. Most of the results are means of twenty experiments; and several of them having been repeated at long intervals and by different hands, without any important difference in the means, the author is of opinion that they express the truth, at the same time that they may be open to some numerical rectification.

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(FIFTEENTH NOTICE.)

(Continued from page 119.)

"The genesis and constitution of aniline red," says Dr. Hofmann, "still remain to be investigated, though the chemical nature and composition of the substances are no longer doubtful." To the elucidation of these matters, the author of this report has largely contributed, while, as we have said, his claim to the discovery of aniline red is indisputable. The method by which he obtained it may yet be utilised, since we find in this report, in an extract from the proceedings of the *Société Industrielle de Mulhouse*, the following statement made by a mixed committee of chemists and manufacturers appointed to examine the question:—"We can," say the Committee, "by repeating Dr. Hofmann's process, prepare aniline red without danger, and with certainty of success, and we see no obstacle to the application of the process on a large scale; being convinced that in following the same process, but employing Payen's refrigerator, the operation may be carried on in an open vessel, and consequently without pressure."

Dr. Hofmann, our readers will remember, first obtained aniline red by heating together aniline and tetra-chloride of carbon in sealed tubes. The great obstacle to the extended use of this method, we imagine, would have been the cost of the chloride of carbon; but this obstacle, we believe, is now removed, since we have recently had our attention called to a specimen of the chloride which, we are informed, was made by a process that will enable it to be produced almost as cheap as sulphide of carbon. This process, we have no doubt, will attract the attention of manufacturers, and, perhaps, seeing the numerous possible applications of chloride of carbon, lead to great results.

Aniline red, as Dr. Hofmann obtained it, was largely contaminated with secondary products, and baffled his efforts to separate it. Mr. Nicholson, however, by his process, obtained a crystallised compound; and with this Dr. Hofmann resumed his researches, and soon "demonstrated that the aniline reds are salts of a peculiar and extremely remarkable compound, which plays the part of a well-defined base, and which the reporter proposes to designate by the name of *Rosaniline*.

"Rosaniline, in the anhydrous state, is represented by the formula $C_{20}H_{19}N_3$, and in the hydrated state, such as it assumes when isolated from its compounds, by the formula $C_{20}H_{21}N_3O = C_{20}H_{19}N_3,H_2O$.

"It is a triamine capable of combining with one, two, or three equivalents of acid. The pure aniline reds are saline compounds of rosaniline with one equivalent of acid.

"It is very interesting that rosaniline itself, when freshly prepared, is a colourless compound. It is nearly insoluble in water; slightly soluble in ammonia; more soluble in alcohol, with a deep red colour; and insoluble in ether. When exposed to the action of the air, rosaniline becomes rapidly rose-coloured, and finally of a deep red, probably in consequence of the formation of a carbonate. It is rather a powerful base, forming salts, almost all of which are remarkable for their beauty, and the facility with which they crystallise."

The monacid salts exhibit by reflection the lustrous metallic green colour seen in Mr. Nicholson's crowns. By transmitted light they are seen to be red, and their solutions possess the well-known magnificent crimson colour. According to Chevreul, the green colour reflected from the crystals is exactly complimentary to the red which the salts impart to wool and silk.

The triacid salts of the stronger acids are yellowish brown, both solid and in solution. They are much more soluble in water and alcohol than the monacid salts. Both classes of salts crystallise readily.

Dr. Hofmann proceeds to describe several of the salts—the hydrochlorate, sulphate, acetate, nitrate, chromate, and trinitrophenate; but to these we need not allude further than to remark that the acetate yields the finest crystals, Mr. Nicholson having obtained them an inch in diameter.

The tannates of rosaniline, described by M. Kopp, deserve a longer notice. "They are true carmine lakes, which rival the renowned carmine lake obtained from cochineal. They are entirely insoluble in water, but soluble in alcohol, wood spirit, and acetic acid. In the dry state they do not present the green metallic appearance, but preserve their beautiful carmine red. The tannate of rosaniline is of considerable importance to industry, not only because it is found on nearly all the cotton fabrics dyed and printed in red or rose with rosaniline, but also because, by reason of its insolubility, it enables the manufacturer to make use of the very dilute aqueous solutions which are often obtained during the purification of rosaniline." In fact, the best way of treating poor solutions is to precipitate them with fresh infusion of nut galls, which in a short time precipitates a magnificent red lake, and leaves a colourless mother liquor.

It would be unfair to quit the subject of aniline red without alluding to the labours of many Continental chemists who have been engaged in the examination. Our readers will remember the several contributions of Guignet, Béchamp, Willm, Persoz, Da Luynes, and Salvétat, and, lastly, of M. Kopp, which have appeared in our pages. To the last-named chemist and the author of this Report we owe all the exact knowledge we have of the body.

A colourless body, leucaniline, which bears exactly the same relation to rosaniline as white does to blue indigo, is obtained when a solution of rosaniline in hydrochloric acid is left in contact with metallic zinc. Leucaniline differs from rosaniline by containing two equivalents more of hydrogen.

Rosaniline . . .	$C_{20}H_{19}N_3$
Leucaniline . . .	$C_{20}H_{21}N_3$
Blue indigo . . .	$C_{16}H_{10}N_2O_2$
White indigo . . .	$C_{16}H_{12}N_2O_2$

Oxidising agents, of course, convert leucaniline into rosaniline.

The Reporter passes on to the formation of aniline red, and here alludes to the remarkable experiments by which be discovered that neither pure aniline nor pure toluidine would produce the colour, but that when a mixture of the two bodies was treated with the chlorides of mercury or tin, or arsenic acid, the red colour was instantaneously produced, thereby proving that the two bases must cooperate in producing the result. This, he believes, gives a clue to the genesis not only of aniline red, but the tinctorial ammonias generally, and the Reporter intends to follow it. For the present we are left in the dark, but no doubt light will be thrown on the subject soon.

All the red derivations of aniline, it is remarked, may be regarded as salts of rosaniline. The fuchsine of M. Rénard consists chiefly of the hydrochlorate; azaleine of the nitrate; the crude red from arsenic acid as the arseniate, which, in the course of purification, is converted into hydrochlorate or acetate. A nearly colourless paste, imported from Mulhouse, which when dissolved in acetic acid gives a magnificent solution, is no doubt rosaniline, more or less pure, precipitated from a salt by a powerful basis such as soda or lime.

The phenomena observed in the application of aniline red may be briefly dismissed. When a stuff dyed with the red is acted on by a strong acid, the colour is discharged in consequence of the formation of a triacid salt, which is nearly colourless. By washing, the excess of acid is removed, and a monacid salt with the colour is reproduced. When the same stuff is treated with caustic soda the colour disappears in consequence of the liberation of colourless rosaniline, but, on washing the soda out, the colour reappears, the rosaniline probably becoming carbonated. When ammonia is used, the colour reappears slowly as the alkali evaporates, and quickly if heat be applied. If the fabric dyed with rosaniline be left a long time in weak ammonia, the colour scarcely returns on rinsing with water, obviously owing to the increased solubility of rosaniline in water containing ammonia, which separates the colour even from the mordant. The ease with which silk and wool are dyed by rosaniline salts is well known, and the animalisation of cotton is now well understood. Mr. Perkins' introduction of tannin as a mordant for cottons, and Mr. Crum's method of using glutin, have now removed all difficulties in the way of applying these dyes to vegetable fibres.

The yellow, green, blue, and black derivatives of aniline come next under notice.

The Prescriber's Analysis of the British Pharmacopœia. By J. Birbeck Nevins, M.D. Lond., &c., &c. London: Churchill and Son. 1864.

This is the first instalment of a long series of books which will appear on the British Pharmacopœia, and for the medical practitioner in either England, Ireland, or Scotland, we are doubtful whether any one more useful can be published. It is, however, only what it pretends to be—a prescriber's book—and is not at all intended for those who have to prepare medicines.

A few extracts will best show the scope of the book :—

"*Acidum Hydrocyanicum Dilutum* contains 2 per cent. of real acid. It is, therefore, the same strength as that of the Ph. L., and a London prescriber will not alter his dose; but it is only two-thirds the strength of the Edinburgh acid, and an Edinburgh prescriber must order at least half as much again as he has been accustomed to do. The strength of the Dublin acid varied; and no rule can be laid down."

"*Liquor Ammoniæ Acetatis.*—About five times as strong as Ph. L., and six times as strong as D. and E. It is difficult to assign any reason for this important change of strength without any indicating change of name. *Dose.*—F ʒss. to f ʒv. in an eight-ounce mixture."

Another important change of strength is—

"*Tinctura Aconiti.*—Now only one-third the strength of Ph. L., one-fourth that of Ph. D., and less than one-fifth that of Fleming's tincture. The dose prescribed by physicians varies considerably, but it is recommended that the dose of this mixture should not exceed ♏v. to ♏x. If beyond this dose, it should be very carefully watched, and an interval of at least six hours should be allowed to elapse before it is repeated."

We can recommend this little book to prescribers, who may save themselves the expense of a Pharmacopœia by purchasing it.

NOTICES OF PATENTS.

2887. *Purifying Water.* F. Lipscombe, Strand, London. Dated October 27, 1862.

This invention consists in the preparation and use of a kind of charcoal impregnated with alkali for the purpose of purifying water by filtration. The wood is steeped in a solution of caustic soda or potash for several days, then dried and burnt into charcoal by heating in well-closed crucibles. The charcoal so obtained is afterwards reduced to a coarse powder, and used alone or between porous slabs of earthenware in the construction of filters.

The purification of water here described must be understood as referring merely to the separation of particles held mechanically suspended. By the action of the soda upon the lime salts dissolved in the water a small proportion of flocculent carbonate of lime would be precipitated which might serve as a medium for removing the visible impurities. It must be remembered, however, that the saline constituents of the water would be somewhat augmented by the soda salts passing from the charcoal into aqueous solution.

Grants of Provisional Protection for Six Months.

2589. William Cooke, Spring Gardens, London, "Improvements in the manufacture of saponaceous compounds."—Petitions recorded October 21, 1863.

167. Robert Irvine, Musselburgh, Thomas Richardson, Newcastle upon-Tyne, and John James Lundy, Leith, Midlothian, N.B., "Improvements in the extraction or manufacture of oils from animal substances."—Petition recorded January 21, 1864.

170. George Lander, Glasgow, Lanarkshire, N.B., "An improved treatment of tar or 'dead' oils to obtain products therefrom, and improvements in the apparatus employed in the process."—Petition recorded January 22, 1864.

226. Johann Zacherl, Bury Court, London, "An improved tincture or liquid preparation for destroying insects."—Petition recorded January 27, 1864.

238. William Edward Newton, Chancery Lane, London, "Improvements in the manufacture of certain kinds of soap."—A communication from Jules Mathieu, Rue St. Sébastien, Paris.—Petitions recorded January 28, 1864.

250. Thomas Martin Heathorn, Wateringbury, Kent, "Improvements in machinery for separating liquids from solid substances containing liquids."—Petitions recorded January 29, 1864.

266. William Edward Newton, Chancery Lane, London, "Improvements in the manufacture of aluminium."—A communication from Nicolas Bassett, Rue St. Sèbastien, Paris."—Petitions recorded January 30, 1864.

268. Alexander Prince, Trafalgar Square, Charing Cross, London, "Improvements in the manufacture of artificial pavement, which improvements are also applicable to pottery ware."—A communication from Victor Duprat, Bordeaux, France.

270. Charles John Rowsell, Stockwell Villas, South Lambeth Road, Surrey, "Improvements in apparatus for viewing photographic and other pictures, coins, and medals, which is also applicable in the production of drawings and paintings."—Petitions recorded February 1, 1864.

276. William Henry Baldwin Castle, Portsmouth, Southampton, "A new or improved composition for coating and insulating metals, wood, cork, and other materials."

284. John Weir Draper Brown and Joseph Williams, Moorgate Street, London, "Improvements in gas burners, especially applicable to railway lamps and lanterns."

301. Eugen Lucius, Chatham Place, Blackfriars, London, "Improvements in the separation and purification of colours."

305. Joseph Lee and James Thomson, Liverpool, "Improvements in mounting photographic and other pictures."—Partly a communication from Malcolm Mouat, Niagara Falls, U.S.

307. Robert Owen, Manchester. "Improvements in apparatus for filtering water and other liquids."

329. François Alexandre Laurent and John Casthelaz, Rue St. Croix de la Bretonnerie, Paris, "Improvements in manufacturing violet colouring matters."

Notices to Proceed.

2550. Fedor de Wylde, Trinity Square, Tower Hill, London, "Improvements in the induration of stone, cement, stucco, brick, or other analogous materials, also in the manufacture of artificial stone."

2555. Arnold Budenberg, Manchester, "An improved blasting powder."—A communication from Bernhard August Schäffer and Christian Friedrich Budenburg, Buckau, Magdeburg, Prussia.—Petitions recorded October 19, 1863.

2607. Richard Archibald Brooman, Fleet Street, London, "A new material for tanning."—A communication from Antoine François Michel, Lyons, France.

2878. William Cowan, Edinburgh, Midlothian, N.B., "Improvements in gas meters."—Petition recorded November 17, 1863.

218. George Darlington, Minera, Denbighshire, "Improvements in the manufacture of zinc white."—Petition recorded January 26, 1864.

Royal Institution.—Tuesday, March 15, at three o'clock, Professor Marshall "On Animal Life." Thursday, March 17, at three o'clock, Professor Marshall "On Animal Life." Friday, March 18, at eight o'clock, Professor Tyndall, "Contributions to Molecular Physics." Saturday, March 19, at three o'clock, Professor Frankland "On the Metallic Elements."

CORRESPONDENCE.

Professor Frankland on the Glacial Epoch.

To the Editor of the Chemical News.

Sir,—In your report of my discourse on the Glacial Epoch there is an important error which I will thank you to correct in your next Number. In the table showing the height of the snow-line in Norway the numbers in the column headed "Coast" ought to have been in that headed "Interior," and *vice versa*. The following is the corrected table :—

	Height of snow-line in feet.		
Latitude.	Coast.	Interior.	Difference.
60°	4450	5500	1050
62°	4150	5200	1050
64°	3650	4200	550
66°	3250	3700	450
68°	3000	3450	450
70°	2900	3350	450

In its uncorrected state the table would prove that the snow-line on the coast is higher than in the interior of the country; whereas it is quoted as evidence of the depression of the snow-line by the warm moist atmosphere of the coast.

I am, &c.

E. Frankland.

Royal Institution, March 7.

MISCELLANEOUS.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following paper will be read :—"Theory of Organic Peroxides," by Sir Benjamin Brodie.

Bankers' Cheques.—A discussion is going on in the *Bankers' Magazine* relative to the utility of Mr. Barclay's patent process for the prevention of forgery by the falsification of cheques. Our readers will find Mr. Barclay's process in Vol. I., p. 224, Chemical News. It appears that the writing on paper prepared by this process can be discharged by careful chemical treatment, which, of course, completely destroys the value of the patent. The subject is one which invites attention, and we shall return to the dispute.

Chemistry at the Custom House.—A short time ago a London chemist imported *syrupy* phosphoric acid from the Continent, upon which the Custom House authorities levied the duty for syrup! The duty was paid by the importer, who preferred to do so rather than appeal to the Commissioners.

New Zealand Exhibition.—An exhibition will be opened at Dunedin, Otago, in January, 1865. The articles exhibited will be classed as in the International Exhibition. No detonating or dangerous substances will be admitted; and spirits, oils, acids, corrosive salts, and things of a highly inflammable nature only by special permission, and in well-secured glass vessels. Application for space and further information must be made to the New Zealand Government agency, 3, Adelaide Place, King William Street, London.

Young v. Fernie.—This important trial has made considerable progress in the past week, and the plaintiff's case is now closed. The defence, we are informed, will last a much longer time. For the plaintiff, Drs. Hofmann, Playfair, and Odling, Sir R. Kane, and Mr. Young were examined to prove that, before the date of Mr. Young's patent, paraffin and paraffin oils had not been obtained by the distillation of bituminous coal as commercial products; that the heat described in the specification as "a low red heat," ranging from 800° to 1000° F. is the temperature at which these products are best produced; that Young's process differs essentially from those of Bnisson (1845) and Hompesch (1841), the first of whom distilled coal at a red heat, whereby naphthaline and an excess of gaseous products would be formed; and the second, schist or clay slates. The great principle of Mr. Young's invention was said, by Dr. Hofmann, to be the temperature and the choice of coal. The case for the defendant contains some curious historical features, a passage from Glauber's "Opera Chemica" being quoted as revealing the germ of Mr. Young's invention; and the method of obtaining "oil of bricks" in the "Pharmacopœia Londinensis" for 1678 is quoted as an illustration of the process. The work of Morand, who distilled coal (?) in 1781, is also brought forward to prove want of novelty in the invention. These matters were not brought forward in the Scotch trial, of which, in other respects, the present is a mere repetition.

Parrot Coal.—Parrot coal is so called, I am told, because it chatters while burning.—*Mr. Young.*

Changes of Name.—The following is a list of the altered names of the chemicals in the British Pharmacopœia :—

Old Names.	New Names.
Ammoniæ sesquicarbonas.	Ammoniæ carbonas.
Antimonii oxysulphuratum.	Antimonium sulphuratum.
„ potassio tartras.	„ tartaratum.
Bismuthi nitras.	Bismuthum album.
Calx chlorinata.	Calx chlorata.
Chloroformyl.	Chloroformum.
Ferri ammonio-citras.	Ferri et ammoniæ citras.
„ carbonas cum saccharo.	„ carbonas saccharata.
„ potassio-tartras.	Ferrum tartaratum.
„ sesquioxidum.	Ferri peroxidum.
Hydrargyri ammonio-chlorid	Hydrargyrum ammoniatum.
„ chloridum.	Calomelas. Hydrargyri subchloridum.
„ bichloridum.	Hydrargyrum corrosivum sublimatum. Hydrargyri chloridum.
„ iodidum.	„ iodidum viride.
„ nitrico-oxidum.	„ oxidum rubrum.
Iodinium.	Iodum.
Magnesia.	Magnesia levis.
Magnesiæ carbonas.	Magnesiæ carbonas levis.
Plumbi oxidum.	Lithargyrum.
Potassæ bitartras.	Potassæ tartras acida.
„ hydras.	Potassa caustica.
Potassii sulphuretum.	„ sulphurata.
Quinæ disulphas.	Quiniæ sulphas.
Sodæ chlorinatæ liquor.	Sodæ chloratæ liquor.
„ potassio-tartras.	„ et potassæ tartras.
Spiritus ætheris nitrici.	Spiritus ætheris nitrosi.
Sulphur.	Sulphur sublimatum.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

A. G. will find the information he wants in Richardson and Watts's "Chemical Technology."

W. Kendrick.—You cannot do without the salts of potash.

A Student.—1. The Giessen "Outlines of Analysis." 2. The latest edition of Rose's "Analytical Chemistry" is the French; we do not know the price. 3. They are not published in any paper.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Estimation of Sulphuric Acid in Salts of the Alkalies.

It is well known that precipitated sulphate of baryta may retain alkaline salts in quantities of 1·5 to 2 per cent. which cannot be removed by the most careful washing. Stolba (*Dingler's Polyt. Jour.*, April, 1863) obtains the sulphate of baryta pure by digesting it (after washing until the wash-waters no longer react of baryta) with 40-50 c. c. of a cold saturated solution of neutral acetate of copper and some acetic acid, at nearly a boiling heat for 10-15 minutes. (The commercial crystallised acetate of copper is purified from sulphuric acid, and at the same time saturated with sulphate of baryta, by adding to its boiling solution a slight excess of chloride of barium and acetic acid, and filtering from the precipitate.) During the digestion, enough acetic acid must be present to prevent the formation of basic salt on boiling. Should basic salt form, which may be readily perceived at the bottom of the vessel, more acetic acid must be added, and the digestion must be renewed for 10-15 minutes. During the process, the vessel containing the precipitate should be constantly agitated. The alkaline salts retained by the sulphate of baryta undergo double decomposition with acetate of copper, and the resulting products all admit of entire separation from the precipitate by means of hot water. The precipitate is washed until no reaction for copper is manifested on mixing the washings with ferrocyanide of potassium. This method the author also found satisfactory for the estimation of sulphuric acid in presence of a large excess of nitrate of baryta and chloride of barium.—S. W. J., in *American Journal of Science and Arts.*

TECHNICAL CHEMISTRY.

New Researches on the Preservation of Building and Ornamenting Materials—Production of Pseudomorphs,

by M. Fred. Kuhlmann.

I have already proved that by operating at low or at moderate temperatures, hydrosulphuric acid transforms native carbonate of lead into sulphide of lead, preserving the form of carbonate of lead crystals; and that under the same circumstances malachite gives sulphide of copper, retaining the fibrous and ribbon-like appearance of malachite; finally that a similar transformation is effected by making sulphuretted hydrogen react on formiate of lead.

I have extended these reactions to the transformation of other crystallised products into sulphides, especially carbonate of thallium, which yielded sulphide of thallium, presenting the prismatic crystallisation of the carbonate; but on repeating these experiments, I found that if, after obtaining these pseudo-morphic sulphides, I kept them in a current of hydrosulphuric acid, gradually raising the temperature, it presently happened that the pseudomorphic crystals were destroyed, and in their place groups of crystals were formed of the shape peculiar to sulphides.

M. Des Cloizeaux was kind enough to carefully examine the artificial crystals, and found them, as to their crystalline form, generally similar to natural sulphides; I have made use of some of the hints given by this learned crystallographer. The current of gas considerably favours these transformations, giving greater mobility to the molecules of sulphides and facilitating their volatilisation. In this way the sulphide of lead produced by the transformation of the carbonate gives by volatilisation magnificent, brilliant-faced cubic crystals. These crystals attach themselves to the interior of the porcelain tubes in which the reaction takes place.

The sulphide of copper produced by the transformation of the malachite gives hexagonal tables without apparent macles, like Breithaupt's cupreine, and appearing to cleave at the base of the crystals. Natural protoxide of copper submitted to a current of hydrosulphuric acid forms a sulphide of copper, with an indigo-blue, crystalline, cuprous crust, corresponding to the natural sulphide known as *kupfer-indig*. According to M. Cloizeaux, cupreine, or hexagonal sulphide of copper, is often naturally associated with malachite.

Other crystallisations of artificial sulphides have been obtained by submitting oxides of silver and cadmium, at high temperatures to a current of hydrosulphuric acid. Sulphide of silver has been obtained crystallised in rhomboidal dodecahedrons, grouped with remarkable precision. Sulphide of cadmium is brown and transparent; it crystallises in regular dodecagonal prisms, terminated by a base or by one or two hexagonal pyramids which have not been determined.

Sulphide of thallium, more volatile than the two preceding sulphides, and in that respect resembling sulphide of lead, gives crystalline flakes, which in a first experiment were agglutinated through employing too high a temperature.

I hoped to obtain under the same circumstances sulphide of zinc, but the action of the hydrosulphuric current on white oxide of zinc produced, not sulphide, but only a yellowish-white oxide, a part of which volatilised and crystallised in flat flakes covered with very small crystals, which seemed to be hexagonal prisms.

General Considerations.—On looking at the various modifications sustained by metallic oxides contained in silicious pastes and in marbles, through the influence of oxidising agents, through reduction or sulphidation, it will be understood that these modifications are sometimes powerful causes of the disintegration of these stones, independently of the changes resulting from their coloration. As water which has penetrated porous stones when it freezes breaks them by its expansion, so oxides becoming peroxidised or by undergoing conversion into sulphides, produce in time disintegration of the hardest stones.

When there is a loss of material by the deoxidation of certain oxides or the destruction of bituminous matters, the stones diminish in hardness and increase in porosity, but in these cases the cause of disintegration is not so great; but if in a given stone 100 of oxygen are increased to 150, or 100 of oxygen were replaced by 200 of sulphur, the case would be very different. In the last instance the causes of disintegration were the same as if in a plaster or in porous stones saltpetre were developed by an abundant fixation of oxygen. Thus by these chemical actions the hardness is often diminished, while the penetration of resin into marble has a contrary effect, as it then becomes much harder and receives a much better polish.

In most of my experiments where modifications of colour have been produced by superoxidation, I have assisted the action of the oxidising agents by a high temperature; but these phenomena no doubt take place at the ordinary temperature solely by the action of atmospheric oxygen. Only in the latter case they are accomplished much more slowly. In proof whereof it is sufficient to examine carefully the action of the air on the outer marble of old monuments—the Dome and Baptistery of Florence are striking examples.

Even coloured jaspers cannot resist the prolonged action of the air, especially if their porousness is increased by solution—through the agency of rain—of the veins of carbonate of lime which often traverse them. The liability of natural stones to alter perfectly accounts for the preference given in former times to enamel as material for mosaics for exterior decoration. Decidedly, if the mosaics of St. Mark's at Venice, St. Peter's at Rome, and the portico of the cathedral of Orveito had been made of stone, they would not have preserved the freshness of colour which we now admire. This remark applies equally to the Pompeian mosaics which form one of the greatest treasures of the Neapolitan museum.

Many of my experiments support the opinion that many of our precious stones are coloured with organic matter, an opinion already stated by M. Levy with regard to the emerald, and by M. Gauthier de Claubry, with regard to red cornelian.

This loss of colour is not confined to these stones, but affects, among others, amethyst, in which oxide of manganese is generally considered as the principal colouring matter. However, Heintz in an analysis of the amethyst found not more than $\frac{1}{10000}$th of manganese; and besides the decoloration of the amethyst in presence of deoxidising gases renders it difficult to disprove the presence of an organic matter. The red quartz of Rabenstein contains about 1 per cent. of oxide of titanium. It would be premature to attribute the red colour of this quartz to organic matters, if it be true that it has the property of recovering its red colour some time after its destruction by heat.

The fact most important resulting from these researches, in a geological point of view, is that when mineral matters have taken by transformation pseudo-morphic forms, their molecules retain a tendency to form crystals or groups of crystals similar to those originally belonging to them, forms which these bodies naturally assume; my results, moreover, show that these transformations may be effected without pressure and under the influence of the same causes which determined the transformation, the only difference being the greater elevation of temperature.

The examples I have cited may throw some light on the various phenomena produced under the influence of volcanic emanations, in circumstances where the production of sulphides is so frequent, and where crystallisations analogous to those of specular oligistic iron may certainly take place. In a work published in 1858[*] I showed that isolated crystals may be produced by the wet way without water of crystallisation. I now give some fresh examples, in which non-volatile, isolated crystals are produced under the influence of gaseous currents at the ordinary pressure by over-exciting the crystallogenic property of certain oxides or sulphides by a high temperature. These facts may help to clear up some obscure points in the study of the numerous modifications which mineral matters on the surface of the globe undergo.—*Comptes Rendus*, lvii., 761. 63.

PHARMACY, TOXICOLOGY, &c.

The British Pharmacopœia.

(Continued from page 124.)

Carbonate of Ammonia is now the name for the compound, $2NH_4O,3CO_2$, generally known as sesquicarbonate. The present name is, perhaps, the best which could be applied in the Pharmacopœia, although the salt has been shown by Rose to be a mixture of $NH_4OCO_2+NH_4O2CO_2$. No directions are given for the preparation of this salt, the ordinary article of commerce being, we suppose, considered sufficiently pure. The tests will show it to be free from sal ammoniac and sulphate of ammonia, and also fixed impurities (lime or chloride of calcium) carried up mechanically in the sublimation.

Chloride of ammonium the Pharmacopœia still calls *Ammoniæ hydrochloras*, although the formula NH_4Cl is adopted. The compilers of the Pharmacopœia commit themselves to the assertion that the salt volatilises *without decomposition*, which was unnecessary, since it would have been sufficient to say, as in the case of the carbonate, that it volatilises entirely when heated.

Most elaborate directions are given for the preparation of *Ammoniæ liquor fortior*. They are very excellent in their way, and some such arrangement of apparatus as is here directed will always be adopted. But it need hardly be said that no pharmaceutist will go to the expense of the apparatus required, and take all the trouble necessary to procure in this way a few ounces of this solution when he can purchase it for about 8d. per lb.

The specific gravity of the new solution is to be 0·891, and it is said that it will contain 32·5 per cent. of ammoniacal gas. The latter point, we presume, has been determined by experiment, since it does not agree with either Davy, Dalton, or Ure's determinations.

The *liquor ammoniæ fortior* of the London Pharmacopœia had the density 0·882, and was said to contain about 30 per cent. of ammonia. This agrees with Davy's table. If, however, the statement in the British Pharmacopœia be true, we require a fresh table of the amount of real ammonia in solutions of different densities. According to Dalton, a solution having the density 0·89 will only contain 24·7 per cent.

The next article in the Materia Medica is *Ammoniæ phosphas*, but we postpone for the present a notice of this salt until we are able to report on the practical results of some experiments with the Pharmacopœia process. We may say at once, however, that the salt intended by and described in the Pharmacopœia is the compound $3NH_4O,PO_5 + 5HO$. Whether this salt can really be obtained in the way directed, and how long it will keep its composition under ordinary circumstances, we are at present unable to say. We are in a similar difficulty respecting the value of the salt if it be obtained.

The antimony compounds call for little remark. The teroxide, *Antimonii oxydum*, is made by adding the terchloride to water, and treating the oxychloride thus precipitated with carbonate of soda. The solution of terchloride, *antimonii terchloridi liquor*, is obtained by treating the tersulphuret with hydrochloric acid. The process for oxysulphuret, *antimonium sulphuratum* as it is now called, remains practically unchanged. The new method of making tartar emetic is to be commended for its simplicity as well as its efficacy. Oxide of antimony and bitartrate of potash are made into a paste, and left in this state—the most favourable for the combination of the two—for twenty-four hours. After this more water is added, and the whole boiled for a quarter of an hour. The solution is then filtered and set aside to crystallise.

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[*] *Comptes Rendus des Séances de l'Academie des Sciences.* Meeting of May 17, 1858.

(To be continued.)

Crystallised Iodide of Iron and Quinine, by M. T. Smedt.

M. Smedt believes he has obtained this salt perfectly defined. The following is his process:—Take sulphide of barium, Q. S., make of it a concentrated solution, which precipitate by tincture of iodine; filter to separate the sulphur, and add sulphate of quinine, say thirty parts, dissolved in very concentrated and suitably acidulated alcohol.

Sulphate of baryta is precipitated, and iodide of quinine remains dissolved in the alcohol, communicating to it a dark yellow colour; filter, and wash the sulphate of baryta with alcohol, and then blend the two liquids; this iodide, separated from its solvent, is of a beautiful yellow orange colour; finally, take twelve parts of iodine and make into a very concentrated solution of iodide of iron, add to it the alcoholic solution of iodide of quinine and heat in a water bath; as the alcohol evaporates, the liquid takes a beautiful green colour, and a small quantity of a resinous substance of a darker colour separates from the liquid. Towards the end of the evaporation again add a little more alcohol, then filter and leave to crystallise; press out strongly the crystals and dry them.

Iodide of iron and quinine obtained in this way is in long yellow needles, quite soluble in boiling water, and not precipitated from it by cooling. This salt dissolves in cold alcohol and ether; it is odourless, and has a bitter ferruginous taste. In short, it seems to present all the characteristics of a perfectly-defined compound. Its composition, however, has not been verified by analysis.—*Journal de Pharmacie et de Chimie*, xliii., 485. 63.

PHYSICAL SCIENCE.

The Spectrum of Carbon.

Dr. Attfield some time ago published[*] an account of the spectrum of the common gas flame, of cyanogen, carbonic oxide, and sulphide of carbon, and finding the same common to all, inferred that it belonged to the one common constituent of these bodies—carbon.

M. Morren, of Marseilles,[†] has experimented with the same bodies as Dr. Attfield, and extended his observations to acetylene, the spectrum of which he finds to be identical with the others. He has, therefore, come to the same conclusion, viz., that the spectrum is that of the vapour of carbon.[‡]

In addition to the lines mentioned by Dr. Attfield, M. Morren describes several in the red band, and mentions that the violet shows as many as eighteen lines. Besides these, he adds that many hundreds of fine black lines, exactly like the lines of interference, are visible; these can only be seen when two or more prisms are employed.

We extract the *resumé* of M. Morren's work:—

"When any hydrocarbon is burnt with oxygen, a brilliant luminous point is obtained, the spectrum of which is the same for all.

"The same gases decomposed by the electric spark give the same spectrum, as also does the vapour of sulphide of carbon, acetylene, and carbonic oxide. The spectrum, therefore, can only be due to an element common to all the compounds; that is to say, carbon in a state of vapour.

"It follows that the theory of the candle flame must be somewhat modified. The base of the flame being blue is the vapour of carbon, preserved from combustion, but kept at a very high temperature by the envelope of hydrogen, the more combustible element of the gaseous carbides from the decomposition of wax; the hydrogen alone uniting with the oxygen of the air. Above the blue part comes the luminous part, produced by the passage of the carbon from the gaseous to the solid state, giving out in the passage a considerable amount of heat. The black cone surrounding the wick of the candle is formed of gaseous carburets of hydrogen, which only burn in the upper part of the flame when they come in contact with oxygen. Hydrogen, besides, being not only very combustible, but very subtle, diffusive, and penetrating, its combustion takes place under conditions in which it would be impossible for other gaseous bodies or vapours to burn. If a candle be gently moved so that the flame may be inclined and the air allowed to come in contact with the vapours of hydrocarbons which surround the wick, we see the hydrogen take fire, and above the flame appears the blue vapour of carbon. The latter can only exist alone, and give its luminous reactions when it has near it the high temperature produced by the combustion of hydrogen. When cyanogen is burnt in a current of oxygen, the high temperature produced in the interior of the flame makes the vapour of carbon intensely hot, and hence very luminous, consequently its spectrum very luminous."

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 3, 1864.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

(Continued from page 126.)

In proceeding with our report of the Society's meeting of this date, we resume the subject by giving the discussion which followed the reading of Professor Abel's paper "*On the Non-metallic Impurities of Refined Copper.*"

Dr. A. W. Hofmann raised a question as to the existence of oxygen in copper in the form of suboxide, Cu_2O; he inclined to the belief that the combination described by Rose as the quadroxide of copper (Cu_4O) should, rather, be found dissolved in the metal. There were difficulties in the way of determining this point with precision; he would, however, ask the lecturer whether he had been enabled to isolate the oxide in question, and observe its physical characters?

Mr. Abel had frequently seen a red oxide remaining on the surface of the metal in its treatment with the silver solution in some of his analytical experiments, but he had never succeeded in collecting a quantity sufficient for an accurate determination of its composition. The amount of oxygen in copper had usually been stated as suboxide, Cu_2O, but with the view of leaving this question open, he had calculated his results both for the proportion of this oxide and for oxygen.

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[*] *Journal of Chemical Society*, series 2, vi., p. 97.

[†] "Des Phénoménes Lumineux que présentent quelques flammes et en particulier celle du Cyanogéne et de l'Acetylène," &c.

[‡] We confess we do not understand what experimentalists mean by the "vapour of carbon," as existing in a flame. It is notorious that no artificial heat yet produced will volatilise carbon, and yet we are asked to believe that the comparatively low temperature of the blue part of a candle-flame is hot enough to keep free carbon in a state of vapour. Moreover, how the carbon gets into the vaporous state requires explanation.—[W. C.]

Mr. **Frederick Field** had succeeded in detecting phosphorus in blister and bar copper, but never in the refined metal. The ores raised in the districts of Coquimbo and Copiapo, Chili, sometimes contained apatite and other phosphatic minerals in association, but the existence of the element, phosphorus, was not discoverable in the reduced metal after the operation of refining. The speaker had found selenium in specimens of copper ore from Bolivia.

Mr. **Alfred Smee** spoke in favour of the electrolytic method as a means of concentrating the impurities from a large quantity of the metal. When the chemical examination of copper was about to be conducted on this plan it was advisable to use a feeble current of electricity and a large positive pole. The melting of electrotype copper was an unsatisfactory operation, for he could never obtain a sound casting with this kind of metal; the ingots were always honeycombed; and on seeking the aid of a practical founder an assurance was given him to the effect that the addition of a small quantity of a "secret material" would at once overcome the difficulty, and produce a perfectly sound casting. At that time he could not, however, listen to the suggestion, inasmuch as his object was then to obtain pure fused copper for certain electrical experiments.

Dr. **De la Rue** had failed likewise in producing sound castings from electrotype copper melted in the ordinary manner, but he believed that better success could be ensured by manipulating the metal in an atmosphere of coal gas.

Dr. A. W. **Hofmann** reminded the Society that the electrolytic method of examination, which had just now been advocated by Mr. Smee, was one which, many years ago, in the hands of the Duc de Leuchtenberg, had furnished a rich harvest of results; but, judging from the long list of impurities then detected, it seemed more convenient to take account, not of those elements which were present, but, rather, of those which were absent.*

Dr. **Matthiessen** had no difficulty in producing sound castings of absolutely pure copper in an atmosphere free from oxygen, and the ingots so obtained were perfectly malleable and ductile. The metallic impurities which were most injurious to the working qualities of copper were three in number, viz., antimony, bismuth, and lead, and these he had usually been able to detect in overpoled copper. In reply to an inquiry on the part of Dr. Hofmann as to the occurrence of arsenic, the speaker stated that he had detected as much as 2½ per cent. of this element in Spanish copper.

Mr. F. **Field**, by way of testimony to the universality of bismuth as an impurity in copper, had recently sacrificed a gold coin of the present currency, in which he had no difficulty in detecting by the iodide of potassium test the presence of bismuth. This metal must have been introduced with the copper used in the alloy. He had examined likewise some Bactrian coins, which also were found to contain bismuth.

Dr. **Hugo Muller** had always detected bismuth amongst the metallic impurities which were left undissolved when commercial qualities of copper were connected with the oxygen pole of a voltaic arrangement.

Mr. **Abel** expressed a doubt as to the general validity of the commonly-received opinion which attributed to the suboxide of copper in the poled metal the power of counteracting the injurious influences of foreign metals. The coincidence of composition observed in the case of samples of tough pitch and overpoled copper examined by him required further elucidation, since with very slight chemical variations great differences were observed in their physical properties. In the examination of refined copper from Copiapo a trace of selenium had been detected.

The **President** then called upon Dr. Frankland to favour the Society with a statement in continuation of his researches "*On the Synthesis of Leucic Acid.*"

Dr. **Frankland** commenced by reminding the Society of the reaction which had first enabled him to produce leucic acid synthetically. By digesting oxalic ether with zinc ethyl, and afterwards distilling with water, he obtained leucic ether, which on treatment with an alkali furnished at once a salt of leucic acid. The relation between oxalic and leucic acids would become manifest by comparison of their formulæ, when it would be seen that the latter was formed from oxalic acid by the substitution of two atoms of the radical ethyl for one of oxygen. Leucic acid might, in fact, be viewed as dimethyl-oxalic acid.

Oxalic acid. Leucic acid.

$$C_2''' \left\{ \begin{matrix} O \\ O \\ OH \\ OH \end{matrix} \right. \qquad\qquad C_2''' \left\{ \begin{matrix} C_2H_5 \\ C_2H_5 \\ O \\ OH \\ OH \end{matrix} \right.$$

Since making these experiments the speaker, working in conjunction with Mr. Duppa, had discovered that the preliminary operation of preparing zinc ethyl might be dispensed with, and that it was only necessary to apply heat to a mixture of amalgamated zinc, iodide of ethyl, and oxalic ether, in proper proportions, in order to prepare at once the leucic ether. By proceeding in this manner a much larger yield than formerly was the result, and the product could be obtained at the ordinary atmospheric pressure. The authors had since applied this principle of formation to the homologous compounds of methyl and amyl. By digesting together the oxalate and iodide of methyl with amalgamated zinc at the temperature of about 100° C., employing an inverted Liebig's condenser to prevent loss from evaporation, the zinc salt of a new acid was formed, from which the corresponding barium and silver salts were prepared, and ultimately the acid itself. For the last substance the authors proposed the name "dimethyl-oxalic acid;" its formula, and that of the original zinc salt, were as follows:—

Dimethyl-oxalic acid. Zinc salt.

$$C_2''' \left\{ \begin{matrix} CH_3 \\ CH_3 \\ O \\ OH \\ OH \end{matrix} \right. \qquad\qquad C_2''' \left\{ \begin{matrix} CH_3 \\ CH_3 \\ O \\ OH \\ OZn_{\frac{1}{2}} \end{matrix} \right.$$

The new acid crystallises in the form of white prisms, which were easily fusible, and might be sublimed without decomposition. By exposure to the air at the common temperature it evaporated slowly like camphor. The barium salt was soluble both in alcohol and water, but not so in ether, and crystallised in brilliant needles. The silver salt was obtained in the state of purity for the purpose of analysis; it crystallised in groups of pearly plates. The most remarkable difference observed between the homologous reactions just now described, consists in the circumstance that no compound corresponding to leucic ether could be obtained in the case of the new acid. All attempts to produce it have hitherto failed, and there was certainly no disposition towards any union being effected by digesting the pure acid with absolute alcohol. The authors were now engaged in the investigation of several other products belonging to the lactic series.

The **President**, after moving a vote of thanks to the authors for their interesting communication, inquired of Dr. Frankland whether it would be possible to leave out the iodide of ethyl in the production of leucic acid, seeing that the required radical was already contained in the oxalic ether?

Dr. **Frankland** replied that oxalic ether could not be employed alone; he found, however, that the new acid might be produced from a mixture of iodide of ethyl and oxalate of methyl.

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* For an account of the Duc de Leuchtenberg's experiments *vide* Hofmann and De la Rue's Annual Report, vol. ii., p. 276.—Ed. *C. N.*

Dr. **Hofmann** asked whether it could be shown that there was really a mutual decomposition brought about on mixing the oxalate of methyl with the iodide of ethyl? and, secondly, not having been present at the reading of the former paper, he was very anxious to learn whether leucic acid produced synthetically was identical, or only isomeric, with the substance described by M. Strecker as being formed by the action of nitrous acid upon leucine?

Dr. **Frankland** considered there was satisfactory proof of a mutual decomposition being induced when the oxalate of one radical was mixed with the iodide of another: thus, a notable depression of temperature, amounting to five degrees centigrade, could be remarked when iodide of ethyl was brought into contact with the oxalate of amyl. The products of distillation also confirmed this opinion. With regard to the properties of leucic acid from the two different sources mentioned, be considered their identity sufficiently established; the physical characters were similar, the melting points were absolutely identical, and the degree of solubility of the zinc salt, as formerly stated by Wagner, accorded with his own results.

Dr. **Hofmann** cited the isomerism of the acetate of methyl and the formiate of ethyl as an instance in which the boiling-points were identical, but the addition of an alkali showed at once the difference in their constitution.

Professor **Wanklyn** remembered reading an account of some experiments made by a French chemist, he believed by Berthelot, which went far towards proving that the radicals in mixed ethers were distributed like metals in salts. Adopting a suggestion offered to the effect that these experiments were made by Friedel and Kraffts, a humorous discussion upon nationalities brought the proceedings to a close, and the meeting was adjourned to the 17th inst., as already reported.

CAVENDISH SOCIETY.

Tuesday, March 1.

The **Master** *of the* **Mint**, *President, in the Chair.*

The seventeenth anniversary meeting of this Society was held at the rooms of the Chemical Society, Burlington House.

The **Secretary** read the following report of the Council:—At the last anniversary meeting, the Council announced the completion of the fifteenth volume of the translation of Gmelin's "Chemistry," which was supplied to members for 1861, and they expressed regret at the delay which attended the production of that volume, although it arose from causes over which they had no control. During the year that has since elapsed another volume of the same work has been in preparation, and it is now nearly ready for publication. This constitutes the sixteenth volume of Gmelin, which will be issued in about a month from the present time as a book for 1862. The editor thinks that one more volume, in addition to that now in hand, will complete the work, with the exception of the index, which is also in hand. A reference to previous reports and to resolutions passed at meetings at which the position of the Society and the progress made in the work it had undertaken have been fully discussed, will serve to explain the causes of the comparative inactivity which has marked the proceedings of the Society for several years past. It is unnecessary to repeat here what has already been said, beyond simply stating that the operations of the Society are now confined to the completion of the translation of Gmelin's "Chemistry," and that the progress made with that work is necessarily limited by the rate at which the German edition is produced. When the Council found that the German work was not produced sufficiently fast to enable the English editor to prepare a volume of the translation every year, they refrained from applying to the members for their subscriptions during the delay that occurred in supplying the books; and on this account the accompanying financial statement gives the receipts and expenditure for the last two years, during which time only one volume has been issued. The Council hope and believe that when the subscriptions are paid up for the present year (1864) there will be funds enough in hand to defray all the expenses of the Society attending the completion of their great and now only remaining unfinished work, and including the index to that work.

Statement of Receipts and Expenditure of the Cavendish Society, from March 1, 1862, to March 1, 1864.

Receipts.

	£	s.	d.
Balance in hand on March 1, 1862	375	15	5
2 Subscriptions for 1855	2	2	0
2 " " 1856	2	2	0
9 " " 1857	9	9	0
25 " " 1858	26	5	0
38 " " 1859	39	18	0
39 " " 1860	40	19	0
47 " " 1861	49	7	0
147 " " 1862	154	7	0
32 " " 1863	33	12	0
1 " " 1864	1	1	0
Sale of Books	55	17	6
	790	14	11

Expenditure.

	£	s.	d.
Petty Cash	1	18	0
Agent, for distribution of books, &c., two years	80	0	0
Insurance, two years	4	8	0
Collectors, two years	12	9	9
Editorial expenses	210	17	6
Paper	67	0	7
Printing	159	14	6
Binding	34	5	3
	570	13	7
Balance in hand	220	1	4
	790	14	11

Examined and found correct,

March 1, 1864. **Henry Deane.**

The usual votes of thanks to the President, Council, and Secretaries were passed.

In acknowledging the vote of thanks to the President, Professor Graham said it would be proper to make a few remarks on the position of the Society. He considered its mission nearly fulfilled. When the publication of Gmelin's "Chemistry" was completed, the Society would have accomplished all that could be expected of it. Societies like the Cavendish in the present day could not compete with private enterprise, which now engaged in publications such as would not have been undertaken at the time the society was commenced. As an illustration, he might mention Galloway's "Second Step in Chemistry"—a work comparable to the volume of memoirs published by the Society, and which would not have been undertaken by a private publisher sixteen years ago. The Society had, in fact, been superseded by the press, and was no longer called for. It might, therefore, be allowed to expire when the great work of Gmelin is completed.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by **Dr. Percy**, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture VII.—*Thursday, January 14, 1864.*

Ladies and Gentlemen,—In the last lecture we entered upon the consideration of sulphur, and the compounds of sulphur which exist in nature. We shall have occasion again to advert to this important branch of chemical geology when we come to speak of volcanoes. Sulphur, I informed you, exists in several states in nature. First, we have it in the isolated state, it being a frequent product of volcanoes. It occurs in a state of combination as sulphuric acid, as in gypsum, which abounds in nature. It is evolved from volcanoes in the form of sulphurous acid, and it also occurs in the form of sulphuretted hydrogen, as in various mineral waters. We then went on to consider certain sulphides, and proceeded as far as bisulphide of iron, iron pyrites, which exists abundantly diffused in nature. I explained to you the methods of producing this substance artificially, so far as they are yet known. In nature it is in general clearly produced in the wet way. It cannot exist at a high temperature. I do not know what the effect of enormous pressure may be—the favourite hypothesis of geologists. When exposed to a red heat in a closed vessel about half the amount of sulphur which iron pyrites contains is liberated. We have positive and direct proof of its formation by the wet way. Of that there can be no doubt whatever. I showed you specimens of common clay ironstone from our coal measures—a material which clearly has never been exposed to the action of a high temperature, and we frequently find in clefts of such ironstone iron pyrites. Again, its association with various mineral substances in lodes—substances which we know have been produced by the wet way—proves clearly that iron pyrites also must have been produced under similar conditions.

We have now to speak of another compound of sulphur and iron—namely, magnetic pyrites, which consists of six equivalents of protosulphide of iron and one of the bisulphide, for such may be regarded as its constitution. There are various modes of stating the rational constitution of this body—six equivalents of protosulphide of iron, that is, a sulphide of iron in which the iron and sulphur are in the proportion of one atom of each, and one equivalent of the bisulphide—$6FeS.FeS_2$, or its formula may be expressed thus :—$5FeS,Fe_2S_3$.

It crystallises in the rhombohedral system, but is rarely met with crystallised. It is feebly attracted by the magnet, and is itself sometimes magnetic. Hence its name. It is brittle, and has a metallic lustre, and a characteristic bronze-like tint. Its specific gravity is 4·6 or 4·7. It is readily fusible, and it is produced artificially by directly heating together sulphur and iron; but this is clearly not the way in which it has been formed in nature—at all events, in many cases. There are many points concerning the precise conditions under which these sulphides and various other compounds have been produced in nature which yet require investigation, and are still very obscure. We may know certainly the fact that a sulphide has been produced by the agency of liquids, but we may not be able to state the precise conditions which have been employed by nature for that purpose. There is one point in connexion with this magnetic sulphide of iron which deserves attention—namely, that it frequently contains nickel. A large quantity of the magnetic sulphide found in Norway, for example, is nickeliferous, and has been worked on account of that metal. In fact, wherever the magnetic sulphide is found in large quantity, it may be desirable to search for the presence of nickel in it, nickel being a metal of considerable value.

Galena, or the sulphide of lead, is frequently found in nature, and contains one equivalent of each of its constituents—sulphur and lead. It is fixed—at all events, under ordinary conditions. It may be fused in a close vessel without sensible loss, yet at high temperatures it may be sublimed, and obtained in a distinctly crystallised form. In nature it occurs magnificently crystallised in cubes, as every one knows who is accustomed to mineralogical cabinets. I have seen it most beautifully crystallised by sublimation in furnace operations. If any one will watch a common lead furnace during the roasting of the ore, in the first stage of the operation he will see little crystals of galena sublimed. Again, in blast furnaces, and in the smelting of lead slags, it sometimes occurs at the top of the furnace, beautifully crystallised. But there is no doubt that in nature it has been generally formed in the wet way, and not by the direct method of fusing its constituents together. We have specimens of common clay iron ore containing galena. Its association with certain mineral substances clearly proves that it has in many cases—certainly in mineral lodes—been formed through the agency of water. I have here, for example, a specimen of galena crystallised upon brown spar—carbonate of iron. The carbonate of iron cannot exist at a high temperature, and we know that it has been deposited by water. If, therefore, we find galena in it, we may be quite sure that the conditions under which these two substances have been produced are essentially the same. It occurs also in association with coal at Bedworth, in Warwickshire. I have seen specimens of large size from that place. There is a curious point connected with galena which deserves attention. I think I may say that all galena, without any exception whatever, contains silver. It has been asserted in some works on mineralogy that certain kinds of galena, like that in Przibram, in Hungary, are free from silver. They are practically free from silver, and do not contain a sufficient amount to render its extraction profitable; but silver is present, I am sure. Never have I met with a single specimen of galena from which I have not been able to extract a sensible amount of silver; and not only so, but I am enabled also to state that gold is a constant ingredient. We have examined many specimens, and never failed to extract a sensible and visible trace of gold—very small, it is true, but sufficient for its identification. And, further, we have never succeeded in finding an ordinary compound of lead, whether litharge, or red lead, or even the lead smoke which escapes from the chimneys of the lead furnaces, from which we have not been able to extract a sensible amount of gold. Here is gold from some thirty or forty specimens which have been examined. All the records of the analyses have been preserved in these hermetically-sealed tubes. This diffusion of gold with lead is a very curious fact.

We now come to the consideration of sulphide of zinc, or blende. Zinc and sulphur may be united when heated, but they then form an infusible sulphide, which protects the subjacent metal from further action. The sulphide of zinc is practically infusible, at all events, in our furnaces. If you take it as thrown down from solution, in the form of a nearly white powder, and expose it to a very high temperature in a crucible, it sinters together, and appears to be somewhat volatile, and its vapour is deposited in a crystalline form. There is no doubt that in nature blende is generally thrown down from solution. I will not say always, because nature has resorted sometimes to several ways of doing the same thing. There are some men who are ardent Plutonists, who believe in nothing but the agency of fire, and there are others who believe in nothing but the agency of water. There is no doubt that nature, in producing the various substances around us, has availed herself of every kind of agency, sometimes using water, and sometimes using fire. It is certain that blende has been thrown down from solution. The same proof I can urge as I urged with respect to the formation of galena and the bisulphide of iron—namely, the conditions under which we find it. It occurs by no means unfrequently in our clay iron ores, sometimes in considerable abundance. I have seen it continually in Staffordshire, filling the cracks of clay iron ores, sometimes associated with copper pyrites, and sometimes with iron pyrites. Here are specimens illustrative of all these points. Here is one piece containing blende of a considerable size. We shall find that when these minerals contain blende it will exist in largest proportions towards the exterior. Senarmont obtained blende crystallised by heating salts of zinc with alkaline sulphides at about 170° centigrade.

Copper pyrites is a very important ore occurring in nature. It is a compound, or may be regarded as a compound, of one equivalent of disulphide of copper, and one equivalent of sesquisulphide of iron. Disulphide of copper is compounded of two equivalents of copper, and one of sulphur—Cu_2S. The formula of copper pyrites is—

$$Cu_2S + Fe_2S_3.$$

It may be prepared directly with certain precautions; and here, again, there is not the slightest doubt—considering the minerals with which we find it associated in nature, and the conditions in which it occurs—that it also, like other sulphides, has been produced generally, if not always, through the agency of liquids. Senarmont made it by heating, at about 250° centigrade, a mixture of protochloride of iron and chloride of copper, in nearly the right proportions to form the sulphide, with a solution of persulphide of potassium in insufficient quantity to decompose the chlorides, and with a great excess of bicarbonate of soda. By this means he got the substance in a crystallised state.

Instead of now taking up the subject which is next in order on the prospectus—namely, sea-water and certain saliferous deposits, I propose to finish the subject of the metals, and proceed at once to iron, that most important and most wonderful of all metals—wonderful in every respect, the most extensively diffused, and the most useful of all metals.

I will first refer to meteoric iron—those masses of iron which are supposed to be minute asteroids, in fact, describing definite planetary orbits. It is not my intention to discourse on the subject of meteorites or aerolites. These masses of iron are remarkable in many respects. The fact of their being alloyed with nickel is curious. We have recently been examining different specimens of iron from different manufactories, and on searching carefully have found in almost every specimen both nickel and cobalt, in very small quantity, but sufficient to prove the general connexion between these three metals. It is not at all improbable that when the search is more extended and conducted with requisite care, we shall find that these metals are pretty generally associated. Here is a magnificent specimen of meteoric iron, the surface of which presents a peculiar structure or pattern developed by the operation of acids. Here on this surface we have the pattern most beautifully shown. With regard to the action of acids on metals, I may state that almost all metals after fusion have a distinctly crystalline structure. It may not be visible to the eye; for instance, if you take a pig of lead nothing will appear to the eye less crystalline, but yet it may be shown that every pig of lead consists of a mass of crystals. Certain metals may present a vitreous structure—if I may use the term with regard to metals—a structure like glass, breaking with a conchoidal fracture.

Experiments might readily be made—and really it were desirable that they should be made on some scale—to ascertain whether we could not imitate these appearances exactly by artificial alloys of iron and nickel. We have now means at our command, with regard both to temperature and obtaining nickel at a moderate cost, which did not exist in former times. The structure which is developed by the operation of acids deserves attention. It is remarkable that a mass consisting of an aggregation of the same crystals should develope this peculiar structure by this etching action. Why should one part be attacked more than another? And yet such is the fact. It is curious, moreover, that certain crystals are acted upon with different degrees of intensity on their different faces.

With regard to these masses of meteoric iron, I think that on a former occasion I alluded to one very curious variety, known as Pallas's meteorite. A similar variety has been found in Atacama, on the slopes of the Andes. These meteorites contain chrysolite, but how it came there I cannot understand. It is singular that a separation should not have taken place between the iron and the chrysolite, as there is reason to believe that the mass must have been exposed to a very high temperature, and the two substances differ very much in specific gravity. This is one of the enigmas which must remain for future solution.

I need not say anything with regard to the supposed source of meteoric iron. Whether meteorites are a segregation of the cosmical dust of which we heard some time ago, I do not know. With reference to that conjecture, Berzelius put the very pertinent question,—If they be composed of this cosmical dust, is it not a strange thing that none should ever have been found on the snow-capped tops of our highest mountains? Reports have been afloat with reference to meteoric sounds in connection with shooting stars, and it is astounding how people who are unaccustomed to the observation of natural phenomena fancy that they see and hear things which have no existence in fact. Only a short time ago, it was stated, with respect to these meteoric sounds, that some mysterious noise, like the falling of crockery, was heard in a house, but no meteor was seen. However, tidings afterwards reached the household of a meteorite having passed about the time the sound was heard, and that was quite sufficient to induce them to attribute the sound to the meteorite. This is a specimen of the kind of evidence on which some of these alleged phenomena rest. Not long ago there was a great noise made in London in consequence of the discovery of an alleged meteorite in a tree. The substance, however, upon examination, turned out to be merely a mass of furnace slag. Very curious things have sometimes been found in trees. The bones of animals have been found embedded in trees, but it is not likely that they have descended from heaven. It is rather strange that we have not had more evidence of the existence of meteorites in former times. I find in *Poggendorff's Annalen* an interesting account of a meteorite discovered deep in sandstone at Oldenburg. It presents the characteristic figures by etching, and is rusted on the exterior exuding drops of sesquichloride of iron. Probably we shall get evidence, at some time or other, of the existence of meteorites in sedimentary beds. They must have fallen, and they ought to be there, or what remains of them ought to be there.

(To be continued.)

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 23, 1864.

E. W. Binney, *F.R.S., F.G.S., President, in the Chair.*

Walter Crum, F.R.S., was elected an honorary member of the Society.

The formation of a Photographic Section was announced.

On the motion of Mr. Sidebotham, seconded by Mr. Parry, it was unanimously resolved that the Sections of the Society, with the consent of the Council, shall have power to elect sectional associates, subject to rules which have been drawn up by the Council. The arrangement to take place immediately, and to continue in force until the end of the ensuing Session.

Professor Roscoe stated that the question of the possibility of taking photographic portraits by means of the magnesium light was now satisfactorily settled; he exhibited some prints of a portrait which Mr. Brothers and he had taken at five o'clock p.m. on Monday, the 22nd, by burning fifteen grains of magnesium in the form of fine wire, at a distance of about eight feet from the sitter. The negative thus produced was stated by Mr. Brothers to be fully equal to any obtained by sunlight in the most favourable state of the atmosphere, the distribution of light and shade was most agreeable, any harshness of the shadows being completely removed simply by slightly moving the wire whilst it is burning. During the meeting, Mr. Brothers took an excellent negative copy of Chantrey's fine bust of the late Dr. W. Henry in the possession of the Society, by burning ten grains of magnesium wire, the light lasting for fifty-nine seconds. It is expected that the quantity of wire necessary for taking a photographic portrait can be sold at the cost of a very few pence.

Mr. G. C. Lowe described a meteor seen by him on Sunday, February 7, at 6h. 11m. p.m. Greenwich mean time. It was first seen just below the constellation Cassiopeia, and was in full view throughout its entire passage, which occupied about four seconds. It descended towards the horizon at an angle of about 40°, passing between the two stars η Pegasi and Scheat, and disappeared without breaking up when at the altitude of α Pegasi. It was of an elongated pear shape, and was followed by a short train of sparks of a dull red colour, the meteor itself being a very pale blue, somewhat less than the diameter of the moon in apparent length, and about six or eight times brighter than the planet Jupiter.

This meteor was also seen by Mr. Wylde, Mr. Parry, and Mr. Pochin, who all described it as one of great brilliancy.

Mr. Sidebotham exhibited a copy by photo-lithography of one of the earliest editions of Shakespere, which he believed to be the first published work in which that process was employed.

Mr. Brockbank exhibited a bead-like fossil body which had been found in a sandstone near Stainmoor, and had been traced to full four feet in length.

The President said that a similar fossil had been described by Mr. George Tate, F.G.S., of Alnwick, in the *Transactions* of the Berwickshire Naturalists' Club for 1858, under the name *Eione Moniliformis*, which was found in the sandstones of the mountain limestone of Howick, Scremerston, and Haltwhistle, in Northumberland and in Yorkshire. Mr. Hindson, of Kirby Lonsdale, has also found the same fossil in sandstones of a similar age in that district, and probably they would be met with in the beds of the millstone grit further south, at Dyke Nook, near Keighley, and Saltersbrook, near Woodhead, where he (the president) had observed specimens of several species of M. Loy's genus of *Crassopodia* with which they have been found associated.

Dr. Roscoe read a paper by Mr. Edward Sondstadt, entitled, "*Note on the Preparation of Calcium.*" Although Davy demonstrated the existence of calcium, and obtained it in an impure condition, by his well-known method more than half a century ago, there are but two methods at present known whereby this most abundant of all the metals, excepting perhaps aluminium, can be obtained in a state of comparative purity. Matthiessen, following a method which was, I think, first indicated by Bunsen, who obtained magnesium by the electrolysis of the fused chloride of magnesium, obtained calcium by the electrolysis of a mixture of the fused chlorides of calcium and of strontium. This method, however, of obtaining the metals of lime and of magnesia is exceedingly troublesome, principally because of the floating up and burning of the metal on the surface of the salt electrolysed. The second of the two methods referred to is that adopted by Liès Bodart, and Gobin, who obtained calcium by heating iodide of calcium with sodium in an iron crucible, the cover of which was securely fastened down. The only objection to be made to this process is the troublesomeness and expense of preparing anhydrous iodide of calcium, which, like chloride of magnesium, is apt to undergo partial decomposition during ignition—and it must be remembered that partial decomposition of iodide of calcium involves the formation of lime, a substance practically infusible, which during the reaction with sodium, must prevent, if present, the aggregation of the minute particles of reduced calcium into globules. In order to overcome this, and the before-named objection to the process, the author fuses together equivalent quantities of iodide of potassium and of chloride of calcium. The fused mass is poured into an iron crucible and covered till cool enough to handle; the mass is then dropped out, and a rather less than an equivalent quantity of sodium is put into the crucible, and the mixture of calcium and potassium salts is placed above it. The crucible is then closely covered and heated to redness. The heat need neither be strong nor long continued. The best results are obtained when the crucible cover is fastened down, but calcium in lump may be obtained without using more pressure than that afforded by a well-fitting lid. The reaction does not appear to be violent, and hence the advantage of considerable pressure. Is the slight violence of the reaction between sodium and the calcium salt owing to the near approach of the two metals as to atomic weight, and thence specific heat? It is easier to obtain calcium in lump by the modification of Liès Bodart's process, that I have described, in a small way, than it is to obtain magnesium in lump on a like scale.

A paper was read by J. C. Dyer, V.P., "*On the Nature of Friction in Mechanics,*" in which he stated that:—Resistance to motion by surface contact arises from distinct kinds of obstruction, according to the nature of the moving bodies and to the condition of their surfaces. These present problems that have been investigated by many writers and experimenters; but no fixed law or rule has been discovered for measuring such resistances as applied to different kinds of friction. The inquiries have mostly related to the action of solid surfaces, and some approach to the measure of their resistance has been attained by finding the relation of falling weights to those sliding over horizontal surfaces of different kinds of woods, metals, glass, marbles, &c.; but little or nothing has been accomplished towards showing the nature of the surface resistance to solids moving through water or other liquids. The experiments of Captain Beaufort and Robert Fulton afford data for the sum of such resistance, but not for its mode of action. In the case of solids, if the surfaces in contact were perfectly level and hard, they would slide over each other without friction; but as none such are known, their resistance to motion arises from the projecting points and indentations, which grapple with more or less force, causing the moving body to rise and fall and to abrade and wear down the surfaces; thus gravity and cohesion constitute the counteracting or compound force called friction. In railway wheels, as small portions of the peripheries are in contact with the rails, when both are in good order but slight resistance is offered; but even in this case the common measure of the weight into the distance does not strictly apply, and the amount of tractive power is obtained from experience only. This retarding force too is divided between the friction on the rails and that of the air passed through. The action of rolling surfaces such as wheels and pinions of watches, clocks, and other machinery, is amply explained, and rules given for minimum friction, in the works of Berthoud, Camming, and Halton, on clocks and watches, by Camus on the teeth of wheels, and in D. Fairbairn's work on mill-gearing, wherein we see that if the rolling surfaces were all smooth, hard, and of curvatures adapted to such motion, they would offer no friction. The motions of shafts on fixed bearings, if the metal surfaces come in contact, will draw in and compress the air, and by heating the shaft prevent safe working; hence lubricating matter is used to limit the contact of the metals, so that only some of their prominent parts touch, to produce attrition, or friction. The motion of bodies through water involved several kinds of resistance of a more complex nature, the measure of which has not been given by any of the able writers on that subject, nor has any formula been applied thereto for solving the questions of the compound resistances to be overcome by ships and other bodies moving through water. Some authors have taken the measure of this resistance to be as the squares of the velocities; but this fails, because the different kinds of resistance are not alike called into action in the different cases adduced. Those of cannon balls ricocheting from water, the sinking of plummets in deep soundings, and floating bodies at different depths from the surface, present each of them reacting forces too complex to admit of any simple rule of measurement, the separate nature of which need not be here repeated; but it may be said that the aggregate of the resisting forces called friction must of necessity consist of the reaction of gravity, inertia, cohesion, elasticity, and adhesion of bodies, in their varied degrees of action, so that no simple measure of them as friction is likely to be discovered, and we thus see that friction is a compound term, pointing to the action of several retarding forces, and to comprehend the nature of these we must analyse these natural forces as they are respectively called into action under the common but vague term of friction.

MICROSCOPICAL SECTION.

Ordinary Meeting, February 16, 1864.

Joseph Sidebotham, *Esq., President of the Section, in the Chair.*

Mr. Brothers presented some very beautiful photographs from microscopic objects to the Section.

Mr. Lynde mentioned that one of the members, Mr. Grindon, had promised to procure a supply of fresh cotton plants, in all stages of growth, beginning in June, and suggested that, as the time for their examination would be during the recess, a committee should be appointed to examine the subject of the cotton fibre very carefully, and report thereon at the first meeting in the next Winter Session.

Mr. Sidebotham suggested that in using very high powers, such as the $\frac{1}{25}$th, if slips of mica were used for mounting the objects, together with mica covers, there would be no risk of damage to these lenses, which could thus be used in many examinations where the fear of damage now prevents their employment.

Mr. Dancer exhibited a new and improved Oxycalcium Microscope; the lenses were adapted to the ordinary form of lantern, and consisted of new combinations of lenses, giving a large flat field, and plenty of light, along with very fine definition. The room was darkened, and Mr. Dancer exhibited an extensive range of objects with several powers, on a large stretched paper screen, eight feet by five feet, showing the application of this instrument to the uses of lectures on various objects. Besides the usual objects, such as sections of wood, objects mounted in fluid, living animalculæ, the process of crystallisation, electrical action, &c., were exhibited. A new combination forming a one-inch object glass for the achromatic microscope was also exhibited by Mr. Dancer, and was much admired.

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(SIXTEENTH NOTICE.)

(Continued from page 130.)

Aniline yellow, to which the name Chrysaniline has been given, is very easily prepared. The residue left after the extraction of rosaniline is submitted to a current of steam, which carries away the base in solution. Nitric acid is added to the condensed liquor, by which chrysaniline is precipitated in the form of a nitrate. This nitrate is so insoluble "that," says the Reporter, "nitric acid may be precipitated even from a dilute aqueous solution by means of the more soluble hydrochlorate or acetate of chrysaniline; these, when poured into a nitric solution, rapidly give rise to the formation of an orange-red crystalline precipitate of nitrate of chrysaniline." Here, perhaps, may be a means of estimating nitric acid and nitrates when present in only small amounts.

Chrysaniline only differs from rosaniline by containing two fewer equivalents of hydrogen.

Chrysaniline . . . $C_{20}H_{17}N_3$
Rosaniline . . . . $C_{20}H_{19}N_3$
Leucaniline . . . . $C_{20}H_{21}N_3$

Aniline green, or Emeraldine, as it has been called by Mr. Crace Calvert, has not yet, we believe, been separated and submitted to chemical investigation. It is obtained on the cloth directly by printing with a mixture of aniline salt and chlorate of potash. The cloth is dried, and in about twelve hours the green colour is developed. On boiling in an alkaline solution, or solution of soap, the green becomes blue, or may be changed into black by treating the fabric with a weak solution of bichromate of potash or bleaching powder.

A greenish-black is also produced when a cloth is printed with a mixture of aniline salt and nitrate of copper. Green or bluish colours are, in fact, obtained when aniline is treated in a variety of ways; but, with the exception of the emeraldine mentioned above, none have any industrial importance. Some of the substances, however, deserve further investigation. There is, for example, the green matter obtained by Dr. Letheby and Mr. Coleman, on submitting a solution of sulphate of aniline to electrolysis. When first deposited, this substance has a beautiful fresh bluish-green colour, which, however, soon becomes dull. When submitted to deoxidising agents, as the mixture of lime and sulphate of iron used for preparing colourless indigo, this substance also furnishes a colourless solution, which again becomes of a dull green when exposed to the air. It is insoluble in water, alcohol, and ether, but dissolves in strong sulphuric acid, giving a solution of a permanent dull, dark green colour. So far as we are aware, the composition of the substance is unknown.

A blue of wonderful beauty is, however, obtained from aniline in an indirect way, by heating for a considerable time a salt of rosaniline with an excess of aniline to about 150° or 160° C. The time necessary for the change will vary according to the amounts employed. A mixture of two kilogrammes of hydrochlorate of rosaniline and four kilogrammes of aniline requires four hours. Together with the blue, some violet and other colouring matters are obtained, and a considerable amount of ammonia is evolved. "The crude blue is purified by treating it successively with boiling water, acidulated with hydrochloric acid, and with pure water, until it presents the purest possible hue." From a boiling alcoholic solution it may be obtained in brilliant needles. In a solid state it presents a copper-coloured metallic appearance, almost without any mixture of green or yellow. For the solution of aniline blue, alcoholic or methylic liquids, acidulated with acetic acid, are generally employed. The slight solubility of aniline blue makes its application to dyeing and printing a little more difficult, but the processes used are nearly the same as those for aniline violet.

Mr. Nicholson purifies the colour by dissolving it in concentrated sulphuric acid, and digesting the solution for half an hour at 150° C. When water is afterwards added to the solution, the blue colouring matter is precipitated in a modified condition, in which it is soluble in pure water.

For our knowledge of the chemical nature of this beautiful compound we are again indebted to Mr. Nicholson and the author of this report. They have established that the blue colouring matters are, in fact, salts of a colourless base. When one of these salts is dissolved in alcohol, and the solution added to alcoholic ammonia, the deep blue colour disappears, and a brownish solution is obtained. Water added to this solution causes the colourless base to separate in the form of a curdy precipitate, which gradually assumes a crystalline character; dried *in vacuo* this substance remains colourless, or becomes slightly bluish. Heated to 100° C, it cakes and becomes brownish, and then is found to be composed of,—

$$C_{38}H_{33}N_3O = C_{38}H_{31}N_3,H_2O_2.$$

This formula exhibits an extremely simple relation between aniline red and aniline blue; indeed, aniline blue is triphenylic rosaniline,—

Aniline red $C_{20}H_{19}N_3,H_2O$ Rosaniline

" blue $C_{20}\left[\begin{matrix}H_{16}\\(C_6H_5)_3\end{matrix}\right]N_3,2H_2O$ Triphenlyic Rosaniline

The genesis of aniline blue is represented by the following equation :—

$$\underbrace{C_{20}H_{16}N_3,HCl)}_{\text{Hydrochlorate of rosaniline.}} + 3\underbrace{\left[\begin{matrix}C_6H_5\\H_2\end{matrix}\right\}N\Big]}_{\text{Aniline.}} = C_{20}\left[\begin{matrix}H_{16}\\(C_6H_5)_3\end{matrix}\right]\begin{matrix}N_3,HCl+\\3H_3N.\end{matrix}$$

Nascent hydrogen and sulphide of ammonium convert aniline blue into a colourless compound corresponding to leucaniline, $C_{38}H_{33}N_3$.

We quote the next paragraph at length:—

"The recognition of the nature of aniline blue has led to some experiments which seem likely to become [have become] of industrial importance. Seeing that the substitution of three atoms of phenyl for three atoms of hydrogen in rosaniline, induces a change from red to blue, the idea naturally suggested itself to replace the hydrogen by other radicals, such as methyl, ethyl, and amyl. Experiment has furnished results of some interest. Rosaniline is readily attacked by the iodides of those radicals; a series of new substances being produced, obviously the salts of trimethyl-, triethyl-, and triamyl-rosaniline, the blue colours of which are similar to that of the phenylated compound."

We shall shortly have to notice the specification of a patent for producing these compounds, which has just been published, so shall not allude to them further at present.

Rosaniline salts, when boiled with aldehyde, or even with crude wood-spirit, assume a permanent blue colour, but the nature of this colouring matter is unknown. Tannate of rosaniline easily undergoes this modification of colour.

Mulhouse blue is made by boiling nitrate of rosaniline with a solution of gum lac and carbonate of soda.

In connection with aniline colours there is only one more matter to which we can allude, and that is the application of the secondary products in the composition of writing and printing inks. The mixture of carbon and oxide of chromium obtained in the manufacture of aniline violet is already extensively used for a printing ink. A writing ink of remarkable permanence was exhibited in the French Department of the Exhibition, which Mr. De la Rue recognised as a secondary product of the manufacture of these colours. More recently, Mr. Dale, of Manchester, has noticed a secondary product of the manufacture of aniline violet by means of chloride of copper, which possesses a black colour, and is able to resist the most powerful chemical agents.

We have now done with the aniline colours. In our notices of this part of the report we have endeavoured to place before our readers a knowledge of the results practically obtained in the manufacture of these remarkable and beautiful compounds, together with the scientific information and suggestions by the Reporter, which may serve to guide an independent experimenter. A new dye is a great prize, and, although the ground is well occupied, there is still hope for well-directed skill.

Lastly, it must be mentioned that aniline has been employed medicinally. Bolley found the vapour of aniline to relieve the irritation caused by the inhalation of chlorine. Salts of aniline have also been administered for several disorders, with results as uncertain as attend the use of most medicines. It is said, however, that patients taking the remedy always acquire an ephemeral blue colouration —a fact, perhaps, of some physiological interest. Aniline itself, it must be remembered, is a strong poison, while the salts (the sulphate has been in general employed) in moderate doses seem to possess no toxic properties.

We have yet to notice the coloured derivatives of naphthaline, chinoline, and phenol.

Annalen de Chimie et de Physique. February, 1864.

The greater part of this number is devoted to physics. Two of Professor Graham's papers are reproduced, "*On Liquid Transpiration*," &c. (1861), and his last contribution "*On the Molecular Mobility of Gases.*" It seems strange that the former contribution should appear at this late date in such an important periodical. M. Athanase Dupré contributes two important communications "*On the Mechanical Theory of Heat*," the second of which merits attention, but unfortunately is not adapted for our columns. A chemical examination of Roquefort cheese is contributed by M. Blondeau. This cheese is stowed away in cellars, where it remains for some time before it acquires the flavour which recommends it to the taste of some people. The changes it undergoes in the cellar in the course of two months will be seen by the following analyses of M. Blondeau :—

Fresh Cheese.

Casein	85·43
Fatty matter . . .	1·85
Lactic acid	0·88
Water	11·84
	100·00

Cheese Two Months in a Cellar.

Casein	43·28
Margarine	18·30
Oleine	14·00
Butyric acid . . .	0·67
Salt	4·45
Water	19·30
	100·00

Thus it is seen that a considerable part of the casein becomes converted into margarine and oleine. M. Blondeau believes the transformation to be due to a mycoderm of the genus Penicillium. The change of casein into butter—which the above proportions of margarine and oleine nearly represents—is remarkable, and leads the author to think that butter is formed in the animal economy at the expense of casein.

M. Le Guen gives a short account of some experiments which go to prove that wolfram up to 2½ per cent. increases the hardness and tenacity of cast iron as well as steel. Beyond this proportion, however, it is prejudicial.

M. Alluard's experiments "*On the Boiling Points of Binary Mixtures of Liquids which Dissolve Mutually in all Proportions*," which are here published at length, we have already alluded to in the notices of the proceedings of the Academy of Sciences.

Examples of Quantitative Analysis for the Use of Students in the Royal Agricultural College, Cirencester. Printed for the College. 1864.

This set of examples will be found extremely useful by all teachers and students of agricultural chemistry. It includes concise but clear instructions for the quantitative analysis of water, manures, and soils, some foods (oil-cake, turnips, mangold, &c.), and also dairy products.

The examples are well chosen, and the methods good, and we can heartily recommend the book to all engaged in the study or practice of analytical chemistry applied to agricultural matters.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

310. Sir John Scott Lillie, Pall Mall, London, "Improvements in apparatus for propulsion by atmospheric pressure."

332. James Webster, Lee Crescent, Birmingham, "Improvements in the preparation of paints or varnishes."

339. Joseph Toussaint, Camden Town, London, "Improvements in the manufacture of cement and artificial stone."

346. Peter Spence, Newton Heath, Lancashire, "Improvements in the manufacture of sulpho-cyanide of ammonium and other sulpho-cyanides."

373. James Hicks, Hatton Garden, London, "An improvement in barometers."

381. Gerard Finch, Clarendon Gardens, Maida Hill, Middlesex, "An improvement in the mode of applying steam or other fluid pressure acting on a piston to produce circular motion."

387. Peter Armand Lecomte de Fontainemorean, South Street, Finsbury, London, "Certain improvements in the manufacture of methylic ether, and its application to the production of artificial ice."—A communication from Charles Tellier, Passy, near Paris.

403. James Wadsworth, Heaton Norris, Lancashire, "Improvements in the methods of softening or dissolving bone, horn, hair, leather, curriers' shavings, raw hide scraps, wool, woollen rags, or other animal matters."

Notices to Proceed.

2553. Henry Gilbee, South Street, Finsbury, London, "An improved composition for rendering boots and shoes and other similar articles waterproof."—A communication from Louis Poncelot, Rue de la Fidélité, Paris.

2575. Charles Garton, Bristol, and Thomas Hill, Southampton, "Improvements in evaporating, cooling, and melting, and in apparatus employed therein."—Petitions recorded October 20, 1863.

2605. Charles James Pownall, Jermyn Street, Westminster, "Improvements in preparing and cleansing vegetable fibres, and in machinery employed therein."—Petitions recorded October 22, 1863.

2614. Alfred Joseph Martin, Vernon Terrace, Roman Road North, Bow, Middlesex, "An improved burner for burning petroleum, paraffin, or other hydrocarbon oils consuming the smoke without the use of a draught chimney."

2618. Victor Julien Cassaignes, Rue de Rivoli, Paris, "Improvements in the manufacture of the prisms, lenses, and glasses of stereoscopes, and in ornamenting glass."

2620. James Parker, Lilford Road, Camberwell, Surrey, "Improvements in the application of steam combined with air as a motive power, and for other purposes."—Petitions recorded October 23, 1863.

2623. William Betts, Wharf Road, City Road, London, "Improvements in the manufacture of metallic capsules for bottles and similar vessels, and in the apparatus or means for applying or fixing such capsules thereon."

2628. Francis Bryan Baker, Sherwood Street, Nottingham, "Improvements in apparatus used in dressing lace and other textile fabrics, and suitable also to the application of dyes or colouring matters thereto."

2629. James Brown, Aldgate, John Thomas Way and Thomas Mullett Evans, Leadenhall Street, London, "Improvements in preparing cements and varnishes."

2682. John Haworth, Hart Street, Bloomsbury, London, "Improvements in the improved method of conveying electric signals and telegrams without the intervention of any continuous artificial conductor."

2700. William Tasker, jun., Waterloo Ironworks, Upper Clatford, Southampton, "Improvements in the making of safety paper, and in the machinery or apparatus employed therein "—Petitions recorded October 31, 1863.

2945. James Smith, Liverpool, "An improved composition for coating or covering the bottoms of ships."—Petition recorded November 23, 1863.

3044. James Bowron, South Stockton, Yorkshire, and George Robinson, Welbeck Street, Cavendish Square, London, "Improvements in the manufacture of soda and sulphuric acid."—Petition recorded December 3, 1863.

CORRESPONDENCE.

The Word "Radical."

To the Editor of the Chemical News.

Sir,—It appears that the orthography of the word "radical" is gradually undergoing a change, the result of which appears now to be favouring the adoption of the word "radicle." There can be no doubt that the former was held to be the correct mode of spelling in the early days of chemistry; and inasmuch as these words have distinct meanings or definitions assigned to them in the dictionaries, it would be well to decide upon their interpretation and proper mode of spelling before proceeding to employ them as terms in discussing the merits of the various systems of nomenclature which are likely before long to suffer a radical change.

I will mention a few facts. Fownes's "Chemistry" retains the use of the old word "radical," whilst Watts's "Dictionary" sanctions the newer style of spelling. Recent authors have generally adopted the latter; amongst them I notice particularly Drs. Debus, Frankland, Matthiessen, and Playfair, Messrs. Buckton, Erlenmeyer, Foster, Schorlemmer, and Wanklyn. Mr. C. Greville Williams changed his opinion as to the mode of spelling between the dates of April and September, 1862, and adheres to the new word. Dr. Maxwell Simpson and others continue to employ the original "radical."

It would be interesting to know whether we are all agreed as to its exact meaning.—I am, &c., J. S.

March 12, 1864.

Oxygennesis.

To the Editor of the Chemical News.

Sir,—As I am professionally concerned for Mr. J. Robbins in the solicitation of his patent for the very beautiful and simple mode of obtaining oxygen gas, to which he has given the above name, I am naturally anxious that the validity of the patent, when completed, should be unimpeachable; and I am, therefore, desirous of saying a few words in reply to the observations which Dr. Squire appears to have made upon the process in question.

Dr. Squire doubts the value of the patent, because Professor Brodie some years since pointed out that when peroxide of barium was treated with an acid solution of bichromate of potash, oxygen was evolved. This was, however, a matter of mere experiment, and the same result might have been arrived at by simple reasoning upon the reaction of the substances recognised.

It has been repeatedly held, however, that the results obtained in the course of mere experiments do not vitiate a patent afterwards applied for, and under which the invention can be made commercially available. I trust, therefore, that your readers and the public will not be led to infer from Dr. Squire's observations that Mr. Robbins' patent will be untenable, or can be invaded with impunity.

As to the value of a quick and simple mode of obtaining oxygen there can be but one opinion. It will place within the reach of the physician an important therapeutic agent, readily applicable to cases in which its exhibition is known to be desirable, and will, probably, also lead to the employment of oxygen in cases in which its use has not been hitherto suggested or employed.

Now that oxygen can be so readily obtained, might not its agency be tried in cases of suspended animation, and also of poisoning with the neurotic poisons? But this is a matter which must be left to the medical profession.

I am, &c.,
E. P. H. Vaughan.

British and Foreign Patent Agency, 15, Southampton Buildings, Chancery Lane, March 16.

MISCELLANEOUS.

Royal Institution of Great Britain.—Probable arrangements for the Friday evening meetings after Easter, 1864:—

April 8. John Percy, M.D., F.R.S., "On recent Improvements in the Smelting of Iron and the Manufacture of Steel."

April 15. Professor Abel, F.R.S., "On the Chemical History and Application of Gun-cotton."

April 22. Professor Blackie, of Edinburgh, "On Lycurgus."

April 29. Professor Alex. Williamson, F R.S., "On the Question whether there be any Proof of the Existence of Atoms."

May 6. Professor Roscoe, F.R.S., "On Indium and recent Discoveries in Spectrum Analysis."

May 13. J. Scott Russell, Esq., M.A., F.R.S., "On the Mechanical Nature and Uses of Gun-cotton."

May 20. James Nasmyth, Esq., M.R.I., "On Day and Night in the Moon."

May 27. Reginald S. Poole, Esq., of the British Museum, "On Greek Art, as Illustrated by Coins."

June 3. Professor Frankland, F.R.S.

June 10. Professor Tyndall, F.R.S., M.R.I.

Pharmaceutical Society. — Lectures on the British Pharmacopœia.—Lecture IV. Wednesday evening, March 23, at half-past eight o'clock, by Professor Bentley, M.R.C.S. V. Wednesday evening, April 13, at half-past eight o'clock, by Dr. Attfield, F.C.S. VI. Wednesday evening, April 20, at half-past eight o'clock, by Dr. Attfield, F.C.S.

Hypochlorites and Kaolin in Paper.—There is a very simple mode of determining the presence of these bodies in papers, of which the pulp has not been sufficiently washed. It is to moisten the sheet with a diluted solution of iodide of potassium. If there are hydrochlorites in the paper, a brown spot is formed, more or less dark, by the action of iodine, which produces a blue colour, if the sheet has been sized with starch. Moreover, these papers always give an acid reaction, and an odour more or less sensible of chlorine. The presence of kaolin is also easily shown. A definite weight of the paper, previously dried, is incinerated, and the residue weighed. Paper of good quality ought to leave only 2 per cent. of ash. French filtering paper leaves only 2 decigrammes of residue to 100 grains of dried paper, and good Swedish filtering paper (papier Berzelius) used in chemical analysis leaves, after combustion, only $\frac{1}{250}$th of its weight. Nevertheless, it is now very usual to meet with papers which contain $\frac{1}{8}$th and even $\frac{1}{4}$th of their weight of kaolin. A sample of paper prepared with glycerine, sent to me by M. Bois, a printer at Brussels, gave a residue of near 30 per cent. of mineral substances, consisting chiefly of silica and alumina; ingredients which, by their excessive quantity, justify the term of mineral paper being applied to this manufacture. Some idea of the enormous use of kaolin may be formed when it is known that M. L. Piette, in his talented "Journal des Fabricants de Papier," estimated in 1854 at more than 50,000,000 kilogrammes the quantity of this substance used in the paper-mills of Europe to mix with rags.—(*Dr. Van Den Corput in "Technologist."*)

TABULAR VIEW OF THE CHEMICAL ARTS.

Class.	Group.	Principal Subjects.
I. Calorics.	1. Fuel and Furnaces.	Coal, wood, coke, &c. Reverberatory, blast furnaces, &c.
	2. Warming and ventilation.	Stoves, hot air, steam, water.
	3. Pyrotechny.	Matches, gunpowder, fireworks.
II. Plastics.	1. Pyroplastics.	Glass, enamel.
	2. Pottery.	Brick, earthenware, porcelain.
	3. Hydroplastics.	Lime, mortar, gypsum.
III. Metallurgy.	1. Pyrometallurgy.	Reductions of ores by fire.
	2. Hydrometallurgy.	Galvanoplastics, photography.
IV. Chemics.	1. Salines.	Oil of vitriol, soda, nitre, alum.
	2. Metallosalines.	Metallic salts, pigments.
	3. Pharmaceutics.	Inorganic, organic.
V. Calistics.	1. Textile fabrics.	Bleaching, dyeing, calico printing.
	2. Sheet fabrics.	Paper, leather, caoutchouc, gutta percha.
	3. Adhesives.	Resin, varnish, glue.
VI. Oleics.	1. Oils and Fats.	Extraction and fining, &c.
	2. Saponification.	Soap, essences, perfumery.
	3. Illumination.	Chandlery, gas, burning fluids, lamps, jets.
VII. Sitepsics.	1. Farina, &c.	Starch, flour, sugar.
	2. Fermentation.	Alcohol, wine, beer, vinegar.
	3. Culinary arts.	Preparation and preservation of food.
VIII. Biotechnics.	1. Physiology.	Plants and animals, ashes.
	2. Manures.	Putrefaction, mineral manures.
	3. Products.	Milk, fat, bone, horn.

—*Professor J. C. Booth in the "Technologist."*

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E C.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 6d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

A Whitelaw.—Received with thanks. Will appear shortly.

H. H.—The Report cannot be obtained separately. The Council very meanly keep it back in order to sell the volume containing all the reports.

A Constant Reader.—Cats will drink prussic acid and milk with avidity. Put half an ounce in a saucerful of milk, and leave it out all night.

J. B.—Makin's or Mitchell's Manual of Assaying.

A Subscriber.—Iron, if present, can be removed by Schwartz's patent process. Have you a chalybeate water?

A Constant Reader writes as follows:—"Required the strength of a solution of chloride of zinc, stated by a French writer to be at 85° of Gay Lussac's areometer?"

Received.—J. A.; C. W. Heaton; Report of the Manchester Scientific Students' Association.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*On the Behaviour of Sulphide of Mercury with Sulphide of Ammonium, by Dr. A. Claus.**

During a toxological examination by Professor von Babo and myself, we observed that in presence of mercurial oxides the test recommended by von Babo and Fresenius for the discovery of arsenic gave some very peculiar and unusual reactions, which are well worthy of especial notice.

We received two stomachs containing poison, and some boxes of pills called Lange's pills, supposed to possess poisonous properties also; nothing was, however, stated about the symptoms exhibited by the deceased, or the supposed nature of the poison. The examination of the pills proved that, besides calomel, they contained nothing of importance. A portion of the stomach was treated with chlorate of potash and hydrochloric acid, and sulphuretted hydrogen passed through the solution, which produced a dirty grey precipitate; to free this of every trace of organic matter, it was, according to Fresenius, still further treated with nitric and sulphuric acid, and reprecipitated with sulphuretted hydrogen. This precipitate contained a considerable amount of sulphur, but possessed by no means the yellow colour of sulphide of arsenic. To prevent the free sulphur retaining any traces of arsenic, it was treated instead of ammonia with sulphide of ammonium, wherein it proved readily soluble.

Hydrochloric acid produced in this solution again a grey precipitate containing sulphur; this was dried, mixed with dry cyanide of potassium and soda, and fused in an atmosphere of carbonic acid. During this operation, the colder end of the tube became covered with a black sublimate, which could not, however, be taken for arsenic, as it produced no garlic-like odour; neither gave the hydrochloric acid solution when tested in Marsh's apparatus any indications of arsenic. The black sublimate or mirror proved insoluble in hydrochloric acid, but easily so in nitro-hydrochloric acid. This led us to suspect the presence of sulphide of mercury, and a piece of gold leaf introduced into the aqua regia solution proved our suspicion to be correct.

To verify these remarkable reactions, which stand in perfect contradiction to the statements of all scientific works (where sulphide of mercury is stated to be insoluble in sulphide of ammonium), I made some experiments with recently precipitated pure sulphide of mercury, and always found a portion of it soluble in sulphide of ammonium. Acids precipitate it again, and as only small portions of it pass into solution, the precipitate becomes large, mixed with sulphur, and assumes a grey, dirty yellowish colour, which might be mistaken for arsenic. In all my experiments, this precipitate, when fused in an atmosphere of carbonic acid with cyanide of potassium and soda, gave black mirrors of sulphide of mercury, which, by further examination, may easily be distinguished from the arsenical mirror. In the first instance, it is of a deeper black, and far less metallic in lustre; secondly, the arsenical mirror, when chased about in a glass tube, leaves the heated place under the appearance of a bright metallic lustre, and condenses again on the cooler spot with well-defined metallic limits, while the open end of the tube exhales most distinctly the alliaceous smell. The sulphide of mercury mirror is not by any means so volatile, neither does it show any of the above-mentioned characters. The best and most certain distinction is, however, its insolubility in nitric acid, and the amalgamation of the gold leaf in the aqua regia solution.

The circumstance, that in fusing the precipitate with cyanide of potassium and soda no metallic mercury is obtained, may be explained by the excess of sulphur always present in the precipitate; and with regard to its black colour, I may mention that in subliming small quantities of sulphide of mercury we never get a sublimate of the red vermilion colour, but on account of the fine division it usually appears black. I have mentioned before that the only ingredient of importance found in the pills was calomel, and as in the further examination of the stomach it was also proved that death resulted from mercurial poisoning, it remained to explain the poisonous nature of the calomel. Some of the pills were a few years old, and on inspection these were found to contain metallic mercury and corrosive sublimate from spontaneous decomposition of the calomel, the metallic mercury being easily discernible by a simple magnifying glass.

This spontaneous decomposition of calomel into mercury and corrosive sublimate, under certain conditions, bears a most important part in pharmaceutical preparations containing this drug, and the use of pills containing it, when old, should be avoided.

TECHNICAL CHEMISTRY.

Utilisation of Brine—A Practical Application of Dialysis.

Mr. Whitelaw, of Glasgow, has recently described the result of a patent process of his own for utilising the brine of salted meat. When fresh meat, he said, had been sprinkled with salt for a few days, it was found swimming in brine. Fresh meat contained more than three-fourths of its weight of water, which was retained in it as in a sponge. But flesh had not the power to retain brine to that extent, and in similar circumstances it absorbed only about half as much saturated brine as of water, so that under the action of salt flesh allowed a portion of its water to flow out. This expelled water, as might naturally be expected, was saturated with the soluble nutritive ingredients of the flesh—it was, in fact, juice of flesh—soup—with all its valuable and restorative properties. In the large curing establishments of this city very considerable quantities of this brine were produced, and thrown away as useless. This was the material to which Mr. Whitelaw has applied the process of dialysis, and he thought with success, for the removal of the salts of the brine, and for the production at a cheap rate of pure fresh extract of meat. His process he stated as follows:—The brine, after being filtered to free it from any particles of flesh or other mechanical impurities it might contain, was then subjected to the operation of dialysis. The vessels or bags in which he conducted the operations might be made of various materials and of many shapes, but whatever might be their material or shape he called them "dialysers." Such an apparatus as the following would be found to answer the purpose:—A square vat made of a framework of iron filled up with sheets of skin or parchment paper in such a way as to be water-tight, and strengthened if necessary by stays or straps of metal. The sides, ends, and bottom being composed of this soft, dialysing material, exposed a great surface to the action of the water contained in an outer vat, in which the dialyser was placed. He found a series of ox bladders fitted with stop-cocks, or gutta-percha mouth tubes, and plugs, and hung on rods stretching across and into vats of water, a very cheap and effective arrangement. He could also employ skins of animals, either as open bags or closed, and fitted with stop-cocks, or bags of double cloth, with a layer of soft gelatine interspersed between them. Other arrangements would readily suggest themselves, and might be adopted according to circumstances. But supposing the bladder arrangement was taken, which, he thought, would be found practically the best, being cheap, easily managed, and exposing a great surface to the dialytic action. The bladders were filled with the filtered brine by means of fillers, and hung in rows on poles across, and suspended into vats of water. The water in those vats was renewed once a day, or oftener if required, and he found that actually at the end of the third or fourth day, according to the size of the bladders employed, almost all the common salt and nitre of the brine had been removed, and that the liquid contained in the bladders was pure juice of flesh in a fresh and wholesome condition. The juice as obtained from the "dialysers," might now be employed in making rich soups without any further preparation, or it might be concentrated by evaporation to the state of solid extract of meat. The liquid from the dialysers might be treated in several ways. It might be evaporated in an enamelled vessel to a more or less concentrated state, or to dryness, and in these various conditions packed in tins or jars for sale. It might be concentrated at a temperature of 120°, by means of a vacuum-pan or other suitable contrivance, so as to retain the albumen and other matters in a soluble form. Again, the more or less concentrated liquid might be used along with flour used in the manufacture of meat biscuits. The products he had named were all highly nutritive, portable, and admirably adapted for the use of hospitals, for an army in the field, and for ships' stores. The dialysis of brine might be conducted in salt water, so as to remove the greater portion of its salt, and the process completed in a small quantity of fresh rain or other water. In this way ships at sea might economise their brine, and so restore to the meat in a great measure the nutritive power that it had lost in the process of salting. Thus, then, Mr. Whitelaw obtained an extract of flesh at a cheap rate, from a hitherto waste material. Two gallons of brine yielded one pound of solid extract, containing the coagulated albumen and colouring matter. For the production of the same directly from meat, something like twenty pounds of lean beef would be required. The quantity of brine annually wasted was very great. He believed he was considerably under the truth when he said that in Glasgow alone 60,000 gallons were thrown away yearly. If they estimated one gallon as equal to seven pounds of meat in soup-producing power, then this was equal to a yearly waste of 187 tons of meat without bone. Estimating the meat as worth sixpence per pound, this amounted to a loss of 10,472*l*. In this way the waste over the country must be very great. In the great American curing establishments the brine wasted must be something enormous, as he found that in eight of the Federal States 4,000,000 pigs were slaughtered and cured last season. Mr. Whitelaw concluded by quoting from Gregory and Liebig as to the value and efficacy of extract of meat.

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* *Annal. der Chem. und Pharm.*, Feb., 1863, p. 209.

The Production of Sulphur in Italy, by M. P. BIANCHI.

THE sulphur at present produced in Italy amounts to no less than 300,000 tons a-year, the value of which in the rough state is 30,000,000 francs. This yield, which has increased tenfold since 1830, is furnished in great part by Sicily. The quantity produced in Romagna, formerly but small, has since increased to 8000 tons per annum.

During the last ten years great improvements have been introduced in the method of extracting sulphur from its calcareous gangue. It is always obtained by liquefaction by burning a portion of the ore; but this operation formerly performed in small, open, cylindrical furnaces (*calcarelle*) is now effected by simply heaping the stones and covering them with earth as in charcoal burning. These heaps, called *calcaroni*, are of considerable size, often four hundred times larger than the old furnaces. This new mode of operating has the advantage of diminishing the losses occasioned by the production of sulphurous acid, so that the yield of sulphur is increased by one-fifth; besides sulphur can be burnt in this way near houses and gardens, which with the old method was out of the question. Formerly it was burnt only at certain periods of the year, now it can be burnt at any time, so that it is no longer necessary to accumulate large quantities of ore. Finally, the operation, which used to be very frequently fatal to the workmen, is now almost harmless.

Sulphur of Romagna and the Marshes.—At Bologna there is a society called "Société des Mines de Soufre des Romagnes," which possesses eight mines, five in the province of Forli (Romagna) called Firmigoano, Luzzena, Fosco, Busen, and Montemamre. The other three, forming part of the province of Urbino and Pesaro, are those of Perticara, Marazzana, and Montecchio.

Most of the sulphur from these workings is refined at Rimini, whence it is carried to the places where it is most in demand, such as Venice, Trieste, Ancona, Lombardy, Toscany, &c.

This refined sulphur is chiefly used for making sulphuric acid, and lately for the treatment of the vine. Its price, which varies considerably, is, in cakes, from 213fr. 10c. per English ton of 1·015 kilogrammes, and in sticks from 254fr. 35c., put on board vessels in the ports of Rimini and Cesenatico, and delivered at the stations of Rimini and Cesana.

Sulphur from the Neapolitan Provinces.—Sulphur is found here in several places, but in small quantities. It is thus found in the volcanic region of Solfatares, where it exists mixed with clay and other matters, from which it is separated by sublimation, but the yield is insignificant. Small deposits of it are found scattered in the district of Majella, one of which is worked at Santa-Liberata. It has recently been announced that there has been discovered at Civita-Nova a bearing of calcaire impregnated with sulphur, but nothing has been said as to its richness and extent. No more is known of another bearing at Santa-Regina, two miles east of Ariano.

Sulphur of Sicily.—Sulphur exists here in a gypseous bed, layers of which extend over a small portion of the island, from Mount Etna to near Trapani. This formation belongs to a geological epoch which has not yet been positively determined. Here, as in Romagna, it contains, besides gypsum, calcaires and clays, more or less marl. In the first case, the sulphur exists in a state of mixture, sometimes uniformly, sometimes irregularly, sometimes in small parallel veins, and more rarely in the form of crystals; in the latter case it is not unusual to find it associated with *cœlestine*, or sulphate of strontium. In clay, on the contrary, it is found in globular masses, which is also the case in similar bearings in Continental Italy.

There are about fifty mines in Sicily, employing 20,000 workmen. The most productive mines are in the provinces of Caltanisetta and Girgenti; ranging next in importance are those of the provinces of Catana, Palermo, and Trapani. The sulphur is extracted in the manner above described by means of *calcaroni;* the loss during the operation amounts to one-third of the ore. Most of the sulphur is exported in the crude state, but little being refined in the island. In this state it is divided into three qualities, the second and third being subdivided into three other qualities. The yield in 1861 was estimated at about 250,000 tons of commercial sulphur, of which about half was produced by the province of Caltanisetta, a third by Girgenti, 25,000 by Catana, and 20,000 by Palermo; the quantity produced by the province of Trapani is very inconsiderable. Most of the sulphur is exported to France and England.

The price of this product has risen during the last few years; in 1860 it sold in the crude state for from 15 to 20 frs. the ton.—*Moniteur Scientifique*, v. 799. 63.

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture VII.—*Thursday, January* 14, 1864.

(Continued from page 139*)*

We will now direct attention to the oxides of iron. These oxides play a very important part in the economy of nature.

The first of which I shall speak is protoxide of iron. We know, literally, nothing of this compound in its isolated state. It consists of one equivalent of oxygen and one of iron, and forms the basis of common iron salts. One French observer tells us that he has made it in a particular way, but very few persons have ever seen it. It has a very powerful affinity for oxygen, and passes rapidly into a higher state of oxidation. We can separate it, but it immediately passes into a higher oxide.

The next oxide to which I shall refer is the sesquioxide or peroxide, which, as you will see by-and-by, is a most important compound. It is composed of two equivalents of iron and three of oxygen—Fe_2O_3. It crystallises in the rhombohedral system. The crystal is steel grey. There are some very fine specimens here before you. It has a bright metallic lustre; its powder is always red. When in thin scales it transmits a red light. The specific gravity of the native oxide is from 5 to 5·2. Some specimens of the native oxide—even the massive native red oxide—are slightly magnetic. That is an observation for which we are indebted to G. Rose; and I have had an opportunity of confirming it by specimens of our own. I may state that quite recently red oxide of iron has been prepared, artificially, strongly magnetic. That is a new fact. It is not volatile, and yet it may be a product of volatilisation. The magnificent specular iron ore, for example, is a volcanic product, and it may easily be accounted for. Supposing we have the vapour of sesquichloride of iron, there is no difficulty in accounting for the formation of the sesquioxide of iron in volcanic regions. If that vapour be brought in contact with the vapour of water, we get a deposit of crystallised sesquioxide of iron with the formation of hydrochloric acid. The sesquioxide is infusible, except at very high temperatures, and then not without decomposition. It loses a portion of its oxygen when heated to a very high temperature, and passes to the state of magnetic oxide, which is a lower degree of oxidation. This has been determined experimentally by Rose in a porcelain kiln, and we have also confirmed his observation. The sesquioxide occurs magnificently crystallised in nature. There is one variety in the form of micaceous scales, and another which is amorphous. It may be obtained in various ways. One method is treating or fusing common salt with common green vitriol. Then we get a beautiful variety, very much like some kinds of micaceous iron ore which are found in nature—unctuous and greasy. In fact, any mineralogist who got hold of this artificial kind would say that it was a natural product at once. It may be made by heating together chloride of calcium and sesquioxide of iron. Or it may be formed by heating anhydrous sesquioxide of iron in a slow current of hydrochloric acid; or by heating a solution of chloride of iron with carbonate of soda or lime at 200 or 300 degrees centigrade. It occurs abundantly in nature, sometimes filling lodes, sometimes constituting deposits, and at other times existing in beds. It occurs abundantly in Lancashire and Cumberland, and in various other localities, sometimes constituting enormous masses of ore. Occasionally we find it associated with sulphate of baryta. This is the case at Sharkham Point, near Brixham, Torquay. There is a large lode of it near the Mumbles, at Swansea, from which a considerable quantity has been extracted from time to time. It frequently contains silica in the form of quartz crystallised and diffused through it, and sometimes, or, generally, I may say, a large portion of silicate of alumina as well. Frequently there is a large excess of free silica; and this is a very important consideration for our iron masters. Magnificent crystallised sesquioxide of iron occurs at Elba and in Tuscany. It abounds in Sweden, and not unfrequently accompanies magnetite, or the magnetic oxide of iron. In the last Exhibition were fine specimens illustrative of this fact. It occurs pseudo-morphic after magnetic oxide of iron in Siberia, and also at Lake Superior. It is found pseudo-morphus after iron pyrites, as you may perceive in this specimen. It was iron pyrites, but it has now become sesquioxide of iron, the sulphur disappearing, and oxygen taking its place. It is a puzzle to know exactly how this pseudo-morphism has taken place. If iron pyrites is exposed to the weathering action of the air, it is converted, and must be converted, first of all into a common sulphate of protoxide of iron. That becomes oxidised by exposure to the air, passing to the state of a sulphate of sesquioxide of iron. That sulphate of sesquioxide of iron, by the action of water, decomposes into two salts—an acid salt which would dissolve away, and a more basic salt which would remain. We can easily understand the transformation of iron pyrites under these conditions into a highly basic sulphate, and even into hydrated sesquioxide, because we have only to call into our aid bicarbonate of lime, which frequently occurs in mineral waters. The trace of sulphuric acid might be removed, and the gypsum formed washed away, leaving nothing but hydrated sesquioxide of iron. But the difficulty is to understand how the crystals are converted into the anhydrous sesquioxide of iron, and that difficulty remains to be explained. You will see that there is no difficulty in accounting for this by supposing the crystals to be first converted into hydrated sesquioxide of iron in the manner described, and then exposed to a certain degree of heat, whereby the water of the hydrate may be expelled, and the red oxide left. But that theory will not suffice, because we find certain crystals of hydrated sesquioxide of iron which are partially converted on the outside into red oxide of iron. It is perfectly evident that the temperature sufficient to decompose the hydrate could never have existed when such crystals were formed, because if it had it is impossible to conceive that any nucleus of hydrated sesquioxide of iron should remain. You see what a number of conclusions one can sometimes get out of these apparently little facts—exponent facts, which, I trust, will hereafter be of more use to geologists than they have hitherto been.

The formation of this anhydrous sesquioxide of iron in nature is yet unexplained satisfactorily. We can produce it readily enough in our laboratories by means of heat, but there is no reason for supposing that in the conditions in which it has been produced in nature a high temperature has prevailed, or, at least, that remark applies to many cases of the formation of this mineral.

Brown iron ore is the next substance which I shall bring under your notice. The sesquioxide of iron has the property of combining with water, and forming this substance which is hydrated sesquioxide of iron. It is one of the chief ornaments of mineralogical cabinets. We find it sometimes in beautiful radiating crystals consisting of aggregations of fibres forming mamillary masses. It can be produced without difficulty in a variety of ways, both in the laboratory and in nature. It is easily formed by the action of a current of air upon water containing bicarbonate of iron in solution. The carbonate of iron, as I shall show you hereafter, dissolves in water by the agency of carbonic acid. When air is passed through such a solution the protoxide of iron passes to a higher degree of oxidation; it becomes converted into sesquioxide, and takes up water, and thus hydrated sesquioxide of iron is formed. Sesquioxide of iron occurs abundantly in nature; every chalybeate spring furnishes an example of that. Here is a beautiful specimen which I obtained many years ago from Derbyshire, illustrating the formation of this substance in nature. I do not mean that it is beautiful to look at, but that it is beautiful in point of interest; it is a foliated stalactite—one of those things which one finds hanging down from the tops of caves. It consists of delicate *folia* or leaves. Water containing carbonic acid has no doubt percolated through the roof of the cavern, having passed through matter containing oxide of iron, and thus formed on the outside a lamina or layer of sesquioxide of iron; and in course of time a large stalactite like this, consisting of numerous leaves of sesquioxide of iron, has been produced. Brown iron ore may be derived from the decomposition of iron pyrites in the manner described just now; I have here a specimen illustrating this point: it consists of cubes of iron pyrites which have been converted into brown iron ore. Sometimes a nucleus of iron pyrites remains within, as in the case of this specimen. We see exactly what is taking place here through the weathering action of the air and water upon the pyrites. You will remember that in all such instances sulphate must be formed, and we must call into our aid some other agent by which the sulphuric acid generated may be removed; even by the weathering of the silicate of iron it may be produced. All our trap rocks contain a large amount of silicate of protoxide of iron in combination with other silicates. Take the common basalts, of which we have plenty in Staffordshire, These, by the agency of the air, become converted into a brown soil. The protoxide of iron, existing originally in combination with silica, has, by the conjoint action of the air and moisture, been converted into sesquioxide. All our rocks which contain silicate of protoxide of iron furnish a source of brown iron ore. Brown iron ore results also from the weathering action of moist air upon carbonate of iron. There are many examples of this. Any one who has been down to Hastings, and observed those lumps of iron ore by the seashore, will see that, externally, they present a red ring, which is the result of the weathering action upon these lumps. The carbonic acid escapes in proportion as the protoxide of iron with which it was combined passes to sesquioxide. Some years ago, I dug up some specimens near the remains of an old forge, which had been buried for ages—two or three hundred years, for aught I can tell; and they all present this change in a very remarkable degree. We have extensive lodes in the North of England, consisting of hydrated sesquioxide of iron, which is clearly derived from the decomposition of sparry iron ore. In Exmoor the same change has taken place. Then we have a specimen from Cornwall, in which we have a nucleus of carbonate of iron, and can trace the change most completely. Spathic iron ore is one of the chief sources of this mineral. Brown iron ore exists abundantly in various localities. One of the most remarkable sources of it which I have seen in this country is that near Brixham. Close to it is the lode containing red oxide of iron. Here, just behind Brixham, is an enormous excavation, from which the ore has been taken. It was no doubt washed in former times. It is used extensively as a paint. We have abundant deposits of impure brown iron ores in various parts of England. Some was recently discovered in Northamptonshire; and some of the Oxfordshire iron ore consists essentially of impure brown iron ore, or limonite as it is called. In France and Belgium it is worked for the sake of the iron it contains.

I now propose to bring before you a subject which, I think, will interest you. It has not been brought much forward in this country. It is that of the lake ores which occur in Sweden and Finland. In the Exhibition of 1862 there were two or three fine collections of them. Swedenborg, who has written extensively on metallurgical and mineralogical matters, has described these ores at great length—their mode of occurrence and the extraction of them. Everywhere in Sweden, both north and south, the ore was extracted from the bottom of lakes and rivers. It was designated "lake iron ore" (vena lacustris ferri). That in Angermannia, an old province of Sweden, was described as uneven in shape, or sponge-like, of a brown colour, friable under pressure between the fingers, and in fracture resembling cut leather. It occurred in detached portions of variable form, and sometimes of the width of the palm of the hand, and in round grains of the size of grains of barley or wheat, or even of beans. It was not found far from the shores, and it was reproduced in the course of twenty or thirty years. During summer the ore was collected in boats by means of drags, and during winter it was raked up through holes made in the ice. Through the whole of Smaland are lakes from which this kind of ore was extracted, and converted in furnaces in the usual manner into crude iron. So great was the quantity of this ore in Smaland and the neighbouring provinces, that an ample supply might have been obtained for numerous furnaces; and as Swedenborg quaintly expresses it, "*hic Mars uvidus amat fundos lacuum.*" When dry, it was light and porous, as though it did not contain much metal, and yet it yielded a large quantity. The ore varied greatly in richness and in quality, one kind producing the worst, and another the best description of iron. Such was Swedenborg's description. We have further details, which I may present to you, and I give them on the authority of Sjögréen, a Swede, who published a very excellent pamphlet on the subject, illustrative of the Exhibition specimens. These ores are chiefly found in the lakes and streams in the province of Smaland, and as many as five varieties of them are described. They have a concretionary structure, and are designated according to the resemblance of their particles in form and size to certain familiar objects. Their varieties are:—First *pearl ore*. It yields 45 per cent. of iron, is very hard and heavy, and presents a dark brown, oily, shining fracture. It occurs chiefly on muddy or clayey bottoms Second, *bur ore*. It is called after the head of the burdock. It is somewhat spongy, very light, and seldom yields more than 30 per cent. of iron. It breaks easily, and crumbles on drying. It is frequently found on grassy bottoms. Third, *money ore*. It is in small, round, coin-like cakes. We have some of it here. It is more dense than either of the first two. In fracture it resembles the fracture of pearl ore. It yields as much as 40 per cent. of iron. Fourth, *cake ore*. It is in the form of round cakes of from two to six inches in diameter. It is soft, and very light. Its colour is dark grey. It is considered very poor, not containing more than 25 per cent. of iron, and is consequently seldom employed.

It is found on gravelly or clayey bottoms. Fifth, *gunpowder ore*. It is in grains, varying in colour from greenish-yellow to shining black. It is very heavy when pure, and may yield as much as 50 per cent. of iron. It is well adapted for producing iron suitable for castings. It rests on a bottom of fine sand, which it is sometimes nearly impossible to separate from the ore after it has been taken out from the lake. Lake ores are always more or less intermixed with impurities, of which the chief is sand, sometimes to the amount of 30 or 40 per cent. They contain from 20 to 60 per cent. of sesquioxide of iron, and protoxide of iron and manganese, as much as 10 per cent. of silica, from $\frac{1}{10}$th to 4 per cent. of phosphoric acid, and from about 7 to 30 per cent. of hydroscopic water. At one place lake ore was found which contained as much as 20 per cent. of manganese. These ores are universally found in the neighbourhood of reed-banks, and on the slopes of the shallows, in the larger and deeper lakes, in layers from 10 to 200 yards in length, from 5 to 15 yards in breadth, and from 8 to 30 inches in thickness. They never occur in strong currents of water. The same variety is never met with throughout the whole stream; thus, as a rule, gunpowder ore will be found at the beginning, then pearl ore, and, lastly, money and cake ore. Within a short time lake ore is reproduced. We can watch its formation and reproduction. There are instances of lakes where the ore, after having been completely exhausted, collected again in the course of twenty or thirty years to such a degree as to form beds of several inches in thickness. The ores are supposed by some to be of infusorial origin. These are not the bog iron ores, but the lake ores. The bog ore is something quite distinct from the lake ore. The mode of collecting the lake ores will interest you, I think. During the autumn, when the lakes are becoming ice-bound, the collector begins to search for ore. With this view, he introduces a long pole through little holes made in the ice along the slopes of the shallows, and gently strikes the bottom, when, partly by the sound and partly by the touch, he ascertains whether ore is present or not; and he requires long practice in order to perform this work with success. The ore collector marks the boundaries of the bed of ore which he thus discovers with little twigs stuck in the ice, and so acquires legal possession of it. In this manner he marks out as many places as he purposes to work during the winter. When the ice is strong enough, he makes a hole in it about three feet in diameter at the outer boundary of the marked claim, and, through this hole, lets down to the bottom a riddle of perforated iron plate fixed to a long pole. Then, by the use of an iron rake about two feet broad, also fixed to a pole, he collects the ore into a heap at the bottom, and with another rake about six inches broad he fills the riddle, which is taken out and emptied of its contents upon the ice. The ore in this state is mixed with mud, and clay, and sand, and, in order to separate these, it is put into an iron riddle, which is sunk two or three inches below the surface of the water and receives a rocking motion, whereby the impurities pass through, leaving the ore comparatively pure. Two men are generally associated in this work—one being employed in collecting, and the other in washing the ore. If the ore is tolerably plentiful, a man generally collects from half a ton to a ton in a day; but this will obviously depend, not only on his skill, but also on the nature of the ore and the character of the bottom of the lake. In the province of Smaland, during the greater part of the winter, the occupation of ore-collecting is extensively carried on. In 1860, the amount of ore raised in Sweden was about 22,000 tons. I have a number of original analyses of these lake ores from Sweden, which I obtained a short time ago. I shall not trouble you with the details of them all. They are essentially impure hydrated sesquioxide of iron. The following is a selection from these analyses:—

	Lake Ores.		
	From Nelj. Calmare County.	From Hulingen, Calmare County.	From Orasjö, Kronobergs County.
PO_5 . . .	1·128	0·701	0·434
SO_3 . . .	trace.	trace.	trace.
CaO . . .	0·823	0·615	0·677
MgO . . .	0·149	0·162	0·135
Al_2O_3 . . .	5·088	7·894	2·167
SiO_3 . . .	7·146	7·376	10·697
Fe_2O_3 . . .	65·576	68·823	57·081
Mn_2O_3 . . .	3·871	0·640	16·185
Water, organic matter, and loss .	16·219	13·789	12·924

We find in them a little alumina and a little magnesia, as we might expect, and also a little lime. They contain, on the average, about 60 per cent. of sesquioxide of iron, and some contain even 68 or 69 per cent. They all contain more or less of manganese. Water is present in them all —water of combination, of course, as well as the hygroscopic water which is present when they are first obtained. Phosphoric acid is found in every case, but, as far as I can make out, they appear to contain less of it than bog iron ores. From the analyses before me, the maximum of the phosphoric acid is 1·128 per cent., and the minimum is 0·168 per cent.

If we conceive a thick bed of gunpowder ore, extending over a large area, and consolidated and agglutinated by some means—it may be by carbonate of iron, or it may be by silica—so as to form a compact mass, it strikes me that we should get such a bed as we are now finding in Cleveland, and which presents an öolitic structure; and I imagine that such a bed as I have supposed would present an öolitic structure like some of the Cleveland iron ores.

I have next to bring before you another oxide of iron. We have spoken of the protoxide, and we have spoken of the peroxide. We will now speak of the combination of the two, or what is supposed to be a combination of the two—namely, magnetic oxide of iron. This is a great subject, and one of extreme difficulty, in many respects, to geologists and others. This magnetic oxide of iron has played a marvellous part in the economy of nature. It may be regarded as composed of one equivalent of protoxide of iron and one of sesquioxide of iron, so that it consists of three equivalents of iron and four of oxygen. It crystallises in the cubical system. In nature it occurs magnificently crystallised, and sometimes, also, massive. It is a product of various metallurgical operations. Here is a magnificent specimen of crystallised magnetic oxide of iron from chloritic schist, the crystals standing out in a state of great distinctness. In furnace operations we obtain crystals in the same state—sometimes beautifully distinct. It is by no means an uncommon product. I have a specimen of the artificial mineral to which I wish to call your attention particularly. It is a very beautiful specimen, in dodecahedral crystals exactly resembling a Traversella specimen. The artificial mineral in this form is exceedingly rare. I have seen only one specimen. When you examine it in contact with the natural mineral you can hardly recognise the difference.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, January 22, 1864.

On Boiling Water,

By W. Grove, Esq., Q.C., F.R.S., M.R.I.

A paper by M. Donny ("*Mémoires de l'Académie Royale de Bruxelles,*" 1843) makes known the fact that in proportion as water is deprived of air, the character of its ebullition changes, becoming more and more abrupt, and boiling like sulphuric acid with *soubresauts*, and that between each burst of vapour the water reaches a temperature above its boiling point. To effect this, it is necessary that the water be boiled in a tube with a narrow orifice, through which the vapour issues; if it be boiled in an open vessel it continually reabsorbs air and boils in the ordinary way.

In my experiments on the decomposition of water by heat, I found that with the oxy-hydrogen gas given off from ignited platinum plunged into water, there was always a greater or less quantity of nitrogen mixed; this I could never entirely get rid of, and I was thus led into a more careful examination of the phenomenon of boiling water, and set before myself this problem—what will be the effect of heat on water perfectly deprived of air or gas?

Two copper wires were placed parallel to each other through the neck of a Florence cask, so as nearly to touch the bottom; joining the lower ends of these was a fine platinum wire, about an inch and a-half long, and bent horizontally into a curve. Distilled water, which had been well boiled and cooled under the receiver of an air-pump, was poured into this flask so as to fill about one-fourth of its capacity. It was then placed under the receiver of an air-pump, and one of the copper wires brought in contact with a metallic plate covering the receiver, the other bent backwards over the neck of the flask, and its end made to rest on the pump plate. By this means, when the terminal wires from a voltaic battery were made to touch, the one the upper and the other the lower plate, the platinum wire would be heated, and the boiling continued indefinitely in the vacuum of a very excellent air-pump. The effect was very curious; the water did not boil in the ordinary manner, but at intervals a burst of vapour took place, dashing the water against the sides of the flask, some escaping into the receiver. (There was a projection at the central orifice of the pump-plate to prevent this overflow getting into the exhausting tube.)

After each sudden burst of vapour, the water became perfectly tranquil, without a symptom of ebullition until the next burst took place. These sudden bursts occurred at measured intervals; so nearly equal in time that, had it not been for the escape from the flask, at each burst, of a certain portion of water, the apparatus might have served as a timepiece.

This experiment, though instructive, did not definitely answer the question I had proposed, as I could not of course ascertain whether there was some minute residuum of gas which would form the nucleus of each ebuillition; and I proceeded with others. A tube of glass, 5 feet long and $\frac{4}{10}$ths inch internal diameter, was bent into a V-shape; into one end a loop of platinum wire was hermetically sealed with great care, and the portion of it in the interior of the tube was platinised. When the tube had been well washed, distilled water, which had been purged of air as before, was poured into it to the depth of 8 inches, and the rest of the tube filled with olive oil; when the V was inverted, the open end of the tube was placed in a vessel of olive oil, so that there would be 8 inches of water resting on the platinum wire, separated from the external air by a column of 4 feet 4 inches of oil. The projecting extremities of the platinum wire were now connected with the terminals of a voltaic battery, and the water heated; some air was freed and ascended to the level of the tube—this was made to escape by carefully inverting the tube so as not to let the oil mix with the water—and the experiment continued. After a certain time the boiling assumed a uniform character, not by such sudden bursts as in the Florence flask experiment, but with larger and more distinct bursts of ebullition than in its first boiling.

The object of platinising the wire was to present more points for the ebullition, and to prevent *soubresauts* as much as possible.

The experiment was continued for many hours, and in some repetitions of it for days. After the boiling had assumed a uniform character, the progress of the vapour was carefully watched, and as each burst of vapour condensed in the oil, which was kept cool, it left a minute bead of gas, which ascended through the oil to the bend of the tube: a bubble was formed here which did not seem at all absorbed by the oil. This was analysed by a eudiometer, which I will presently describe, and proved to be nitrogen. The beads of gas, when viewed through a lens and micrometer scale at the same height in the tube, appeared as nearly as may be of the same size. No bubble of vapour was condensed completely, or without leaving this residual bubble. The experiment was frequently repeated, and continued until the water was so nearly boiled away that the oil, when disturbed by the boiling, nearly touched the platinum wire; here it was necessarily stopped.

To avoid any question about the boiling being by electrical means, similar experiments were made with a tube, without a platinum wire, closed at its extremity, and the boiling was produced by a spirit lamp. The effects were the same, but the experiment was more difficult and imperfect, as the bursts of vapour were more sudden, and the duration of the intervals more irregular.

The beads of gas were extremely minute, just visible to the naked eye, but were made visible to the audience by means of the electric lamp.

In these experiments there was no pure boiling of water—*i.e.*, no rupture of cohesion of the molecules of water itself, but the water was boiled, to use M. Donny's expression, by evaporation against a surface of gas.

It is hardly conceivable that air could penetrate through such a column of oil, the more so as the oil did not perceptibly absorb the nitrogen freed by the boiling water and resting in the bend of the tube; but to meet this conjectural difficulty, the following experiment was made:—A tube, 1 foot long and $\frac{3}{10}$ths inch internal diameter, bent into a slight angle, had a bulb of $\frac{3}{4}$-inch diameter blown on it at the angle; this angle was about three inches from one end and 9 from the other; a loop of platinum wire was sealed into the shorter leg, and the whole tube and bulb filled with and immersed into mercury; water, distilled and purged of air as before, was allowed to fill the short leg, and by carefully adjusting the inclination, the water could be boiled so as to allow bubbles to ascend into the bulb and displace the mercury. The effect was the same as with the oil experiment, no ebullition without leaving a bead of gas; the gas collected in the bulb, and was cut off by what may be termed a valve of mercury, from the boiling water, then allowed to escape, and so on; the experiment was continued for many days, and the bubbles analysed from time to time; they proved, as before, to be nitrogen; and, as before, continued indefinitely.

A similar experiment was made without the platinum wire, and though, from the greater difficulties, the experiment was not so satisfactory, the result was the same.

As the mercury of the common barometer will keep air out of its vacuum for years, if not for centuries, there could be no absorption here from the external atmosphere, and I think I am fairly entitled to conclude from the above experiments—which I believe went far beyond any that have been recorded—that no one has yet seen the phenomenon of pure water boiling—*i.e.*, of the disruption of the liquid particles of the oxy-hydrogen compound so as to produce vapour which will, when condensed, become water, leaving no permanent gas. Possibly, in my experiment of the decomposition of water by ignited platinum, it may be that the sudden application of intense heat, and in some quantity, so forces asunder the molecules that, not having sufficient nitrogen dissolved to supply them with a nucleus for evaporation, the integral molecules are severed, and decomposition takes place. If this be so, and it seems to me by no means a far-fetched theory, there is probably no such thing as boiling, properly so called, and the effect of heat on liquids in which there is no dissolved gas may be to decompose them.

Considerations such as these led me to try the effect of boiling on an elementary liquid, and bromine occurred as the most promising one to work upon; as bromine could not be boiled in contact with water, oil, or mercury, the following plan was ultimately devised:—A tube, 4 feet long and $\frac{4}{10}$ths inch diameter, had a platinum loop sealed into one closed extremity; bromine was poured into the tube to the height of 4 inches; the open end of the tube was then drawn out to a fine point by the blow-pipe, leaving a small orifice; the bromine was then heated by a spirit-lamp; and when all the air was expelled, and a jet of bromine vapour issued from the point of the tube, it was sealed by the blow-pipe. There was then, when the bromine vapour had condensed, a vacuum in the tube above the bromine. The platinum loop was now heated by a voltaic battery, and the bromine boiled: this was continued for some time, care being taken that the boiling should not be too violent. At the end of a certain period—from half an hour to an hour—the platinum loop gave way, being corroded by the bromine; the quantity of this had slightly decreased. On breaking off, under water, the point of the tube, the water mounted, and showed a notable quantity of permanent gas, which on analysis proved to be pure oxygen. As much as a quarter of a cubic inch was collected at one experiment. The platinum wire, which had severed at the middle, was covered with a slight black crust, which, suspecting to be carbon, I ignited by a voltaic spark in oxygen in a small tube over lime-water; it seemed to give a slight opalescence to the liquid, but the quantity was so small that the experiment was not be relied on. No definite change was perceptible in the bromine; it seemed to be a little darker in colour, and had a few black specks floating in it, which I judged to be minute portions of the same crust which had formed on the platinum wire, and which had become detached.

The experiment was repeated with chloride of iodine, and with the same result, except that the quantity of oxygen was greater: I collected as much as half a cubic inch in some experiments, from an equal quantity of chloride of iodine, the platinum wire, however, was more quickly acted on than with the bromine, and the glass of the tube around it to some extent.

Melted phosphorus was exposed to the heat of the voltaic disruptive discharge by taking this between platinum points in a tube of phosphorus, similarly to an experiment of Davy's, but with better means of experimenting; a considerable quantity of phosphuretted hydrogen was given off, amounting in several experiments to more than a cubic inch.

A similar experiment was made with melted sulphur, and sulphuretted hydrogen was given off, but not in such quantities as the phosphuretted hydrogen. I tried in vain to carry on these experiments beyond a certain point; the substance became pasty, mixed with platinum from the arc, and from the difficulty of working with the same freedom as when they were fresh, the glass tubes were always broken after a certain time. Had I time for working on the subject now, I should use the discharge from the Ruhmkorf coil, which had not been invented at the period of these experiments. At a subsequent period, when this discharge was taken in the vacuous receiver of an air-pump from a metallic point to a metallic capsule containing phosphorus, a considerable yellow deposit lined the receiver, which, on testing, turned out to be allotropic phosphorus. No gas is, however, given off. I had an air-pump (described "Phil. Trans.," 1852, p. 101) which enabled me to detect very small quantities of gas, but I could get none. It was in making these experiments that I first detected the striæ in the electric discharge, which have since become a subject of such interesting observations, which are seen, perhaps, more beautifully in this phosphorus vapour than in any other medium, and which cease, or become very feeble, where the allotropic phosphorus is not produced.

I tried also phosphorus highly heated by a burning-glass in an atmosphere of nitrogen, but could eliminate no perceptible quantity of gas, though the phosphorus was changed into the allotropic form.

It is not difficult to understand why gas is not perceptibly eliminated in the last two experiments; the effect is probably similar to that described in my paper on the "*Decomposition of Water by Heat*," where when the arc or electric spark is taken in aqueous vapour, a minute bubble of oxyhydrogen gas is freed and disseminated through the vapour, recombination being probably prevented by this dilution; but, however long the experiment may be continued, no increased quantity of the gas is obtained, all beyond this minute quantity being recombined. If, however, the bubble of gas be collected, by allowing the vapour to cool, and then expelled, a fresh portion is decomposed, and so on.

So with the phosphorus in the experiments in the air-pump and with the burning-glass; if any gas is liberated it is probably immediately recombined with the phosphorus; possibly a minute residuum might escape recombination, but the circumstances of the experiment did not admit of this being collected, as the gas was with the aqueous vapour.

When, on the other hand, the gas freed is immediately cut off from the source of heat, as when the spark is taken in liquids, an indefinite quantity can be obtained.

Decomposition and the elimination of gas may thus take place by the application of intense heat to a point in a liquid, or also in gas or vapours; but in the latter case it is more likely to be masked by the quantity of gas or vapour through which it is disseminated.

I believe there are very few gases in which some alteration does not take place by the application of the intense heat of the voltaic arc or electric spark. If the arc be taken between platinum points in dry oxygen-gas over mercury, the gas diminishes indefinitely, until the mercury rises, and by reaching the point where the arc takes place, puts an end to the experiment. I have caused as much as a cubic inch of oxygen to disappear by this means. I at one time thought this was due to the oxidation of the platinum; but the high heat renders this improbable, and the deposit formed on the interior of the glass tube in which the experiment is made has all the properties of platinum-black; so if the spark from a Ruhmkorf coil be taken in the vapour of water for several days, a portion of gas is freed which is pure hydrogen, the oxygen freed being probably changed into ozone, and dissolved by the water in this case, while in the former it combined with the mercury.

I have alluded to the eudiometer by which I analysed the gases obtained in these experiments; it was formed simply of a tube of glass, frequently not above 2½ millimetres in diameter, with a loop of wire hermetically sealed into one end, the other having an open bell mouth. By a platinum wire a small bubble of the gas to be examined could be got up through water or mercury into the closed end of the tube, and by the addition of a bubble of oxygen or hydrogen gas, a very accurate analysis of very minute quantities of gas could be made: I have analysed by this means quantities no larger than a partridge-shot.

I need hardly allude to results on the compound liquids, such as oils and hydrocarbons, as the fact that permanent gas is given off in boiling such liquids would not be unexpected; but the above experiments seem to show that boiling is by no means necessarily the phenomenon that has generally been supposed, viz., a separation of cohesion in the molecules of a liquid from distension by heat. I believe, from the close investigation I made into the subject that (except with the metals, on which there is no evidence) no one has seen the phenomenon of pure boiling without permanent gas being freed, and that what is ordinarily termed boiling arises from the extrication of a bubble of permanent gas either by chemical decomposition of the liquid, or by the separation of some gas associated in minute quantity with the liquid, and from which human means have hitherto failed to purge it; this bubble once extricated, the vapour of the liquid expands it, or, to use the appropriate phrase of M. Donny, the liquid evaporates against the surface of the gas.

My experiments are, in a certain sense, the complement of his. He showed that the temperature of the boiling point was raised in some proportion as water was deprived of air, and that under such circumstances the boiling took place by *soubresauts*. I have, I trust, shown that when the vapour liberated by boiling is allowed to condense, it does not altogether collapse into a liquid, but leaves a residual bubble of permanent gas, and that at a certain point this evolution becomes uniform.

Boiling, then, is not the result of merely raising a liquid to a given temperature, it is something much more complex.

One might suppose that with a compound liquid the initial bubble by which evaporation is enabled to take place might, if all foreign gas were or could be extracted, be formed by decomposition of the liquid: but this could not be the case with an elementary liquid; whence the oxygen from bromine or the hydrogen from phosphorus and sulphur? As with the nitrogen in water, it may be that a minute portion of oxygen, hydrogen, or of water is inseparable from these substances, and that if boiled away to absolute dryness, a minute portion of gas would be left for each ebullition.

With water there seems a point at which the temperature of ebullition and the quantity of nitrogen yielded become uniform, though the latter is excessively minute.

The circumstances of the experiments with bromine, phosphorus, and sulphur did not permit me to push the experiment so far as was done with water, but as far as it went the result was similar.

When an intense heat, such as that from the electric spark or voltaic arc, is applied to permanent gas, there are, in the greater number of cases, signs either of chemical decomposition or of molecular change; thus compound gases, such as hydrocarbons, ammonia, the oxides of nitrogen, and many others are decomposed. Phosphorus in vapour is changed to allotropic phosphorus, oxygen to ozone, which, according to present experience, may be viewed as allotropic oxygen. There may be many cases where, as with aqueous vapour, a small portion only is decomposed, and this may be so masked by the volume of undecomposed gas as to escape detection. If, for instance, the vapour of water were incondensable, the fact that a portion of it is decomposed by the electric spark or ignited platinum would not have been observed.

All these facts show that the effect of intense heat applied to liquids and gases is much less simple, and presents greater interest to the chemist, than has generally been supposed. In far the greater number of cases, possibly in all, it is not mere expansion into vapour which is produced by intense heat, but there is a chemical or molecular change. Had circumstances permitted, I should have carried these experiments further, and endeavoured to find an *experimentum crucis* on the subject. There are difficulties with such substances as bromine, phosphorus, &c., arising from their action on the substances used to contain and heat them, which are not easy to vanquish, and those who may feel inclined to repeat my experiments will find these difficulties greater than they appear in narration; but I do not think they are insuperable, and hope that, in the hands of those who are fortunate enough to have time at their disposal, they may be overcome.

To completely isolate a substance from the surrounding air, and yet be able to experiment on it, is far more difficult than is generally supposed. The air-pump is but a rude mode for such experiments as are here detailed. Caoutchouc joints are out of the question. Even platinum wires carefully sealed into glass, though, as far as I have been able to observe, forming a joint which will not allow gas to pass, yet it is one through which liquids will effect a passage, at all events, when the wires are repeatedly heated.

In some experiments with the ignited platinum wire hermetically sealed into a tube of glass, the end of the tube containing the platinum wire was placed in a larger tube of oil, to lessen the risk of cracking the glass. After some days' experimenting, though the sealing remained perfect, a slight portion of carbon was found in the interior liquid. This does not affect the results of my experiments, as I repeated them with glass tubes closed at the end and without platinum wires, and also without the oil bath; but it shows how difficult it is to exclude sources of error. When water has been deprived of air to the greatest practicable extent it becomes very avid for air. The following experiment is an instance of this:—A single pair of the gas battery, the liquid in which was cut off from the external air by a greased glass stopper, having one tube filled with water, the other with hydrogen; the platinised platinum plates in each of these tubes were connected with a galvanometer, and a deflection took place from the reaction of the hydrogen on the air dissolved in the water. After a time the deflection abated, and the needle returned to zero, all the oxygen of the air having become combined with the hydrogen. If now the stopper were taken out, a deflection of the galvanometric needle immediately took place, showing that the air rapidly enters the water as water would a sponge. Absolute chemical purity in the ingredients is a matter, for refined experiments, almost unattainable. The more delicate the test, the more some minute residual product is detected. It would seem (to put the proposition in a somewhat exaggerated form) that in nature everything is to be found in anything if we carefully look for it.

I have indicated the above sources of error to show the close pursuit that is necessary when looking for these minute residual phenomena. Enough has, I trust, been shown in the above experiments to lead to the conclusion that hitherto simple boiling, in the sense of a liquid being expanded by heat into its vapour without being decomposed or having permanent gas eliminated from it, is a thing unknown. Whether such boiling *can* take place may be regarded as an open question, though I incline to think it cannot; that if water, for instance, could be absolutely deprived of nitrogen, it would not boil until some portion of it was decomposed; that the physical severance of the molecules by heat is also a chemical severance. If there be anything in this theoretic view, there is great promise of important results on elementary liquids, if the difficulties to which I have alluded can be got over.

The constant appearance of nitrogen in water, when boiled off out of contact with the air almost to the last drop, is a matter well worthy of investigation. I will not speculate on what possible chemical connection there may be between air and water. The preponderance of these two substances on the surface of our planet, and the probability that nitrogen is not the inert diluent in respiration that is generally supposed, might give rise to not irrational conjectures on some unknown bond between air and water. But it would be rash to announce any theory on such a subject; better to test any guess one may make by experiment than to mislead by theory without sufficient data, or to lessen the value of facts by connecting them with erroneous hypotheses.

ACADEMY OF SCIENCES.

March 14.

THE early day on which we are compelled to go to press obliges us to notice very shortly the proceedings of the Academy. A memoir entitled "*Researches on the Respira-*

tion of Fruits," by M. Cahours, was read, to which we shall have to direct further attention. At present we can only say that the author finds no gases but carbonic acid and nitrogen in fruits. M. Scheurer-Kester sent a continuation of his "*Researches on Le Blanc's Process*," which we shall translate at length. M. Kekulé contributed an interesting letter on the "*Atomicity of Elements*," in answer to the opinions of M. Naguet before referred to. We shall give both these communications in our next. M. Girard sent a short note on the "*Difficulty of Separating Sulphates by means of Alcohol*." When free sulphuric acid is to be estimated in the presence of sulphates, some one (*on*) has recommended that the latter should be precipitated by means of alcohol, and the free acid determined after evaporation. But M. Girard has discovered for himself that some sulphates are slightly soluble in alcohol, and hence exact results are not obtained by the method. The above, probably, is not the process our readers would adopt; but the author's experience is worth having.

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(SEVENTEENTH NOTICE.)

(*Continued from page 142.*)

The magnificent blue dye obtained by the action of iodide of amyl on the chinoleine derived from cinchonine has been described in our pages by the discoverer, Mr. C. G. Williams. Our readers will find a detailed account of the process at page 219, vol. ii., of the Chemical News. "This colouring matter," says the Report, "perhaps the most beautiful known up to the present time, is, unfortunately, so fugitive and so easily acted on by light, that it is destroyed in a very short time. It is much to be regretted that no one has yet succeeded in giving more stability to the chinoleine blue, as the silk stuff dyed with this colouring matter, which exhibit a superb blue by day, reflect violet tints of extraordinary beauty by candle or gas-light." To this we may add, that the *Société Industrielle de Mulhouse* has offered a gold medal and a prize of 10,000f. for the discovery of a method of rendering the colour permanent.

Cyanine, as the colour has been named, may be obtained in the crystalline state, as well-formed prisms, which reflect a green metallic lustre with a golden tint. They are very slightly soluble in water, but dissolve readily in alcohol. The solution is of a magnificent blue colour, with a coppery iridescence on the surface. Acids destroy the colour, while ammonia and caustic alkalies leave it apparently unchanged, but in reality separate it as a finely-divided precipitate floating in a colourless solution.

Dr. Hofmann analysed these green crystals, and found them to consist of "a mechanical mixture of two iodides represented respectively by the formulæ—

$C_{28}H_{35}N_2I$, and
$C_{30}H_{39}N_3I$,

the latter predominating almost to the exclusion of the former." We need not quote further on the chemistry of these interesting compounds, as the reader will find Dr. Hofmann's paper on the subject at page 85, vol. vii., of the Chemical News.

A blue colour, to which the name azuline has been given, is obtained from carbolic acid. The process, patented by MM. Guinon, Marnas, and Bonnet, is shortly as follows:—Ten parts of carbolic acid are heated with from four to eight parts oxalic acid and four parts sulphuric acid, until the colour and consistence of the mixture indicate the operation finished. The product is then washed with water to remove the excess of acid, when a green paste is left behind. One part of this paste is now heated in a digester with two and a-half parts of commercial ammonia for three hours to 150° C. In this way a dense red coloured solution is obtained which will dye silk and wool red. To this red dye the discoverers give the name *péonine*. In order to obtain the blue azuline five parts of péonine are heated for several hours with six or eight parts of aniline. There is a little mystery in the description of the process here, which the learned author of the Report cannot clear up. It is not said whether the péonine is to be used dry or in paste, nor is the temperature stated to which the mixture with aniline is to be submitted. However, if the process be conducted successfully, a blue colouring matter is obtained which can be purified by washing with hot coal gas naphtha and caustic alkalies. Then, after washing with acidulated water and drying, the azuline is obtained as a fine powder with a golden lustre, soluble in wood-spirit and common alcohol, the solution being at once applicable to dyeing and printing. When applied to silk, however, the bath is acidulated with a little sulphuric acid.

Picric acid is another colouring matter derived from phenol, as all our readers know, by the action of nitric acid. We need not describe the process for its manufacture, but it may be new to some to know that the best way of separating the acid from the tarry matter of the crude product is to convert it into a salt—say of soda—taking care to avoid an excess of the alkali, and then, after filtration, to decompose the picrate of soda at a boiling heat, with an excess of sulphuric acid. The picric acid thus separated is nearly insoluble in the mother liquors, and crystallises out as the liquor cools almost chemically pure.

The uses of picric acid itself as a yellow dye are too well known to need description here. It promises, however, to furnish another series of red, purple, and blue dyes; for each of these colours is produced by the action of reducing agents—red, with a ferrous salt and an alkali; purple, with cyanide of potassium and ammonia; and blue, with stannous chloride. Very little is known of these colours, and no one has yet received any practical application.

Naphthaline colours are very briefly noticed in the report. *Naphthazarin*, the substance like alizarine, is remarkable; but unfortunately it dyes a very dull colour, and therefore receives no industrial application.

We have now finished with the coal-tar colours. The space to which our notices have extended oblige us to omit much; but we cannot forbear quoting the eloquent conclusion to this section of the report, for the sake of the moral it inculcates:—

"——— only four [now five] years ago, aniline and its derivations were spoken of by an able writer in the following terms:—'The compounds of aniline are to be reckoned by hundreds; *but they are not the subjects of manufacture; they are not articles of commerce; they are of no use in the arts; they are applied to no use in domestic economy*,' &c. How great the difference between this opinion and the verdict of wondering applause and admiration now pronounced in its favour by the thousands who daily crowd to see at the Exhibition the radiant beauty of its marvellous derivatives!

"Yes! it is not too much to say that the history of the chromatic derivatives of aniline, phenol, naphthaline, and other coal-tar products, is a splendid demonstration of the power and utility of chemistry. But this history teaches us another and a nobler lesson still, and one which, in closing this section, the reporter would once more recall; for it is apt to be forgotten in a great industrial country like England, where fortune ever tempts the chemist from the hard mountain path of pure scientific research to the smiling slopes of lucrative industrial application. That lesson, based on the discovery of benzol, and pointing to the illustrious name of its discoverer, Faraday, bids us, if we would reach the noblest heights of fame, to seek PURE TRUTH; careless of industrial advantage to ourselves, yet sure that from our labours practical good will in due season flow, for the benefit of all mankind."

Some common-place reflections are suggested by the above; but we must leave the reader to make them for himself.

We have now nearly done with this report; but we cannot leave this section without again expressing our thanks to the learned author whose labours have given to the book an interest far more lasting than that which generally attaches to a work of the kind.

CORRESPONDENCE.

Purification of Oxalic Acid.

To the Editor of the Chemical News.

Sir,—Will you allow me to make known in your columns the results of some experiments on the purification of oxalic acid in which I was engaged when I received your number for February 6, containing M. Maumené's method of obtaining this acid practically pure?

Following, as I thought, the directions of Mohr quoted by Fresenius ("Quantitative Analysis," p. 90), I found, with M. Maumené, that the more frequent the crystallisations the richer the crystals grew in impurity, indicated by ignition. As these directions are to leave a large quantity of the acid undissolved by luke-warm water, the author was no doubt quite aware of the difficulties to be overcome, and relied on the acid oxalates being left undissolved. I may have dissolved these up by using water in too great quantity, or of too high a temperature; however this may be, despairing of the whole process, I dissolved all the crops of crystals together in nearly boiling water, with the addition of enough nitric acid to render the liquid strongly acid. The crystals deposited, on cooling, were in thick prisms, and when washed and pressed they left a very small residue; after two crystallisations of these, a crop of crystals was obtained, leaving only when dry ·016 per cent. of a reddish, slightly alkaline residue, and the mother liquor of the crop preceding these gave on evaporation crystals affording ·0159 per cent. of a similar residue, while from the mother liquors of both these crops evaporated together crystals were obtained in which I could not weigh the residue from about 30 grains. As M. Maumené's purest crystals contained ·09 per cent. of residue, it is evidently an excellent plan to render the original water strongly acid in purifying oxalic acid. I am, &c. Henry How.

University of King's College, Windsor, Nova Scotia, February 29.

Bankers' Cheque Paper.

To the Editor of the Chemical News.

Sir,—I see in your last number an allusion to the discussion which is now taking place in regard to the so-called anti-forgery paper for bankers' cheques.

I have been lately engaged in the examination of a few of these papers, and I think that some of your readers may perhaps feel interested in hearing the results of my observations.

The first cheques which were submitted to me were marked "Barclay's Patent Indelible, London," and proved on analysis to contain ferrocyanide of manganese. The paper was white, and was printed with an ink apparently owing its colour to carmine.

I immersed one of the cheques in a dilute solution of hypochlorite of calcium. The whole of the writing speedily disappeared, but a brown stain remained upon the paper. I then washed it, and treated it for a few seconds with dilute sulphurous acid, which restored the paper to its original whiteness. During this process the printed portions were, of course, removed, as well as the written ones; but this would have been the case equally if Mr. Barclay's process had not been applied to the paper. In another experiment I applied the same process to one of Mr. Barclay's cheques on which ordinary printing ink had been used. In this case no difficulty was experienced; the whole of the writing was removed, the printing was unaltered, and although the original green of the paper had acquired a bluer shade, yet it was found easy to restore the colour by tinting with yellow.

I subsequently found that, by the careful use of oxalic acid, it was possible to remove portions of writing even from the carmine-printed cheques without alteration in the colour of the paper, and with scarcely any injury to the printing.

I think it is evident from these facts that Mr. Barclay's process affords no security at all against the removal of writing from paper.

On reviewing the numerous patents which have been taken out at various times for the protection of bankers' cheques from fraud, one cannot help being struck with the want of originality which has characterised a good many of them. The following list of a few of these patents will illustrate this:—

1817.—Gabriel Tigere. Ferrocyanide of potassium incorporated with the pulp.

1837.—David Stevenson. Impure ferrocyanide of manganese in the pulp.

1858.—W. Herapath. Ferrocyanides, ferricyanides, and sulphocyanides, but preferably ferrocyanide of potassium.

1858.—Seyd and Brewer. Ferrocyanide of potassium. (Provisional protection only.)

1859.—Robert Barclay. Various processes are described, but the preference is given to the use of ferrocyanide of manganese.

It is impossible not to see the essential similarity in these five patents. Stevenson evidently intended the use of ferrocyanide of manganese, but he describes a bad process for obtaining it. Mr. Barclay avoids this difficulty by describing no process at all, and then claims a patent right for an original idea!—I am, &c.

Chas. W. Heaton.

Charing Cross Hospital, March 16.

[Dr. Letheby, we are informed, has completely discharged the writing on Barclay's patent paper, without affecting the colour of the paper, by the use of very dilute acid. —Ed. *C.N.*]

MISCELLANEOUS.

Royal Society.—The following gentlemen are proposed for election as members of the Royal Society:—Alexander Armstrong, M.D., William Baird, M.D., Sir Henry Barkly, K.C.B., Henry Foster Baxter, Sir Charles Tilstone Bright, William Brinton, M.D., John Charles Bucknill, M.D., Lieut.-Col. John Cameron, R.E., T. Spencer Cobbold, M.D., the Hon. James Cockle, M.A., Henry Dircks, Alexander John Ellis, John Evans, William Henry Flower, Sir Charles Fox, George Gore, George Robert Gray, Thomas Grubb, Henri Gueneau de Mussy, M.D., William Augustus Guy, M.B., George Harley, M.D., Sir John Charles Dalrymple Hay, Bart., Benjamin Hobson, M.D., William Charles Hood, M.D., Fleeming Jenkin, William Jenner, M.D., Edmund C. Johnson, M.D., Prof. Leone Levi, Walter Augustus Lewis, M.B., Sir Charles Locock, M.D., Edward Joseph Lowe, the Hon. Thomas M'Combie, Sir Joseph Olliffe, M.D., George Waring Ormerod, Thomas Lambe Phipson, John Russell Reynolds, M.D., William Henry Leighton Russell, B.A., William Sanders, Col. William James Smythe, R.A., Lieut.-Col. Alexander Strange, Thomas Tate, Charles Tomlinson, George Charles Wallich, M.D., Robert Warington, Charles Wye Williams, Nicholas Wood, Henry Worms.

Chemical Society.—The annual meeting of the Chemical Society will be held at Burlington House on the 30th inst. The following is the list of officers proposed for election:—*President*—A. W. Williamson, Ph D., F.R.S. *Vice-Presidents, who have filled the Office of President*—W. T. Brande, F.R.S.; B. C. Brodie, F.R.S.; C. G. B. Daubeny, M.D., F.R.S.; Thomas Graham, F.R.S.; A. W. Hofmann, Ph.D., LL.D., F R.S.; W. A. Miller, M.D., F.R S.; Lyon Playfair, Ph.D., C.B., F.R.S.; Colonel Philip Yorke, F.R.S. *Vice-Presidents*—Walter Crum, F.R.S.; Alfred Smee, F.R.S.; John Stenhouse, LL.D., F.R.S.; Robert Warington. *Other Members of Council*—F. A. Abel, F.R.S.; Thomas Andrews, M.D., F.R.S.; Dugald Campbell; H. Debus, Ph.D., F.R.S.; J. B. Lawes, F.R.S.; A. Matthiessen, Ph.D., F.R.S.; Hugo Müller, Ph.D.; E. C. Nicholson; W. J. Russell, Ph.D.; Maxwell Simpson, M.B., F.R.S.; J. T. Way; C. Greville Williams, F.R.S. *Secretaries*—Theophilus Redwood, Ph.D.; William Odling, M.B., F.R.S. *Foreign Secretary*—E. Frankland, Ph.D., F.R.S. *Treasurer*—Warren De la Rue, Ph.D., F.R.S.

Society of Arts.—The following six lectures on "Chemistry applied to the Arts" will be delivered at the above Society, by Dr. F. Crace Calvert, F.R.S., on successive Thursday evenings, at 8 o'clock, commencing March 31:—

Lecture I.—*Bones.*—Composition of raw and boiled bones. The manufacture of superphosphate of lime. Application to agriculture. Bone-black or char, and their use in sugar refining. *Phosphorus*, its properties, extraction, and employment in manufacture of matches. *Horn* and *Ivory*, their composition and applications.

Lecture II.—*Gelatine, Glue, Bone-size, Chondrine*, their preparation, chemical properties, nutritive value, and application to arts and manufactures. Artificial tortoiseshell. *Isinglass*, its adulterations and adaptations to clarification of fluids. *Skins* and the art of tanning.

Lecture III.—*Leather.* — The art of the currier. Morocco, Russia, and patent leathers. The art of tanning skins. Chamois and glove skins. Parchment. *Hair*, its composition and dyeing. *Wool*, its washing, scouring, bleaching, and dyeing. *Silk*, its adulterations and conditioning.

Lecture IV.—*Animal Fatty Matters*, the various processes for liberating them from the tissues in which they are contained. Their composition and conversion into soap. Composite candles. The refining of lard. *Cod-liver*, *sperm*, and other oils. *Spermaceti* and *Wax.*

Lecture V.—*Flesh*, its chief constituents, boiling, roasting, and preservation. *Animal black*, its manufacture and applications. The employment of animal refuse in the manufacture of prussiate of potash. *Prussian blue.* Manufacture of artificial animal manures.

Lecture VI.—*Animal Liquids.—Bile*, its purification and detergent properties. *Blood*, its application in the refining of sugar and the manufacture of albumen. *Albumen*, its use in calico printing and photography. *Urine*, its uses. *Milk*, its composition, properties, falsification, and preservation. A few words on putrefaction.

A full report of the above lectures, corrected by the author, will be published in this Journal.

Silver Alum.—In a letter from Professor Church to the Editor, he announces that he has prepared a silver alum (the idea of the existence of such a compound being due to Mr. Northcote). Equivalent quantities of $Ag_2S\Theta_4$ and $Al_4 3S\Theta_4$ were heated together in a sealed tube in an oil-bath until the $Ag_2S\Theta_4$ had completely dissolved in the small quantity of water present. On cooling, octohedrons were deposited. These were found on analysis to be—

$$Ag_2S\Theta_4,Al_4 3S\Theta_4 + 24H_2\Theta$$
$$=2(AgO,SO_3,Al_2O_3,3SO_3 + 24HO).$$

They were resolved by water into their respective salts.

New Voltaic Pile.—M. Maistre Fils has proposed a new voltaic pile. The peculiarity consists in the employment of iron instead of zinc for the oxidable metal, and in the arrangement of the charcoal or copper discs; these, which are circular, are all placed on a spindle which can be made to revolve; the discs dip into the liquid in the cups to such an extent that about one-third of their surface is covered; the exciting liquid employed is water containing a hundredth part of its volume of nitric acid. Iron is considered better than zinc, because there is no danger of its forming a deposit on the discs, the revolution of which prevents their becoming coated with hydrogen, and so rendered inactive.

New Mode of Illumination.—M. Sonbra, a Professor of Mathematics, has invented a new method of illumination, or rather a method of inverting a flame, by the adoption of which several advantages are expected to be realised. The apparatus consists of a syphon of glass, the open ends of which are turned upwards; a burner is placed just within the shorter branch. Before lighting the lamp, the longer branch of the syphon is heated, and a current of air established, which carries with it any flame placed at the open end of the shorter branch, the flame, consequently, becoming inverted. As soon as the current is established, and the burner kindled, the heating of the longer leg may be discontinued, the current, once established, being sustained by the heat from the inverted flame. The advantages of this new arrangement are as follows:—The supports of the globes or lamp-glasses are placed above the flame, and do not intercept the light; the reflectors, also, are in no danger of becoming blackened by smoke, and they collect rays that otherwise would be lost in the air. The flame has a more elevated temperature on account of the heat being concentrated by the syphon, and the carbon consequently more incandescent. The products of combustion are collected in the syphon, and may be conveyed away, instead of vitiating the air of the apartment. It is proposed to employ these reversed flames as footlights for theatres, the advantages, such as safety, &c., being obvious.

Condensation of a Solar Beam.—M. D. Van Monckhoven has communicated to the French Society of Photography a note "*On the Impossibility of Constructing an Optical Refracting System which will Augment the Intensity of the Solar Rays without Changing their Parallelism.*" He adverts to an arrangement of M. Bertsch, intended to effect this object, consisting of a convergent lens, which is placed so as to receive the solar rays perpendicularly, and, consequently, to form an image of the sun in its focus; a divergent lens is, however, interposed, and placed in such a position that the two foci coincide, and, therefore, rays converging to the common focus would, after passing through the second lens, emerge parallel and concentrated. M. Van Monckhoven demonstrates that although, in the case of a luminous point at an infinite distance, M. Bertsch's reasoning would be correct, it would be inapplicable to the sun's rays, because the sun has a sensible diameter, and since the image formed at its focus by the lens on which the light first fell would necessarily be larger than that which would be formed by the other at its focus, no condensation could possibly take place; M. Monckhoven applies his argument to a slightly different arrangement to that of M. Bertsch, the difference consisting in the employment of a small convex lens placed beyond the focus, instead of a concave one intercepted between the large lens and its focus. To this attack M. Bertsch replies that he has successfully applied this arrangement to photographic purposes, and that the angles of the pencils of rays proceeding from the sun, never exceeding half a degree, are so small that they may be neglected.

Employment of the Electric Light for Scenic Effects.—The electric light appears to have permanently taken its place amongst theatrical properties. In Paris where more attention is paid to scientific effects than in this country, the celebrated optician, Duboscq, has devised some marvellous imitations of lightning and of the rainbow. The former is obtained by a concave mirror, in the focus of which are the two carbon poles of a powerful battery nearly in contact, and so adjusted that when the mirror is rapidly moved in the hand, the poles touch for a brief interval, and flash a dazzling beam of light across the stage. The zig-zag effect of lightning, and its peculiar blue colour, are very perfectly imitated by this means. But more wonderful than this is the rainbow. In the representation of the opera of *Moïse*, it is requisite, in the first act, to introduce a rainbow; and this has hitherto been effected either by painting, or by projecting the image on the scene from a magic-lantern with a coloured slide. In the latter case the stage had to be darkened in order to allow the rainbow to be seen; and this, of course, destroyed the illusion. M. Duboscq, by a happy modification of his spectrum apparatus, and by employing a curved, instead of a straight, slit, and a small-angled prism, has succeeded in projecting the very brilliant electric spectrum on the scene, with the proper curvature and the identical colours of the real rainbow; and this is of such a vividness that it is plainly visible in the full light of the stage. In these days of sensation-spectacles we feel confident that a real rainbow on the stage would attract quite as crowded houses as a "tremendous header," and we are surprised that no manager has introduced so novel an effect this Christmas. —*Chronicle of Optics, Quarterly Journal of Science*, No. 2.

On the Retardation of the Earth's Rotation. —In a contemporary Mr. Garbett takes exception to the concluding paragraph of Dr. Frankland's recent discourse on the Glacial Epoch (CHEMICAL NEWS, vol. ix., p. 116), and contends that the friction of the tides can never do more than reduce the earth's axial rotation to a monthly one. Dr. Frankland thus writes in reply:—"Mr. Garbett has very graphically and truly described the operation of the tides in retarding the earth's diurnal rotation to be, 'in effect, the same as if the earth rubbed slightly against her satellite.' We are thus in accord respecting the result of the tidal friction, so far as a retardation to a monthly rotation is concerned, and we may therefore take this as our point of departure. Arrived at this stage, the earth would constantly turn the same hemisphere towards the moon, and, as a necessary consequence, the oceanic tide due to the moon's attraction would become stationary in longitude, although it would undergo a monthly oscillation in latitude, due to the inclination of the moon's orbit to the plane of the earth's equator,—the accumulation of the oceanic waters occurring in the line of the centres of the earth and moon. Thus the friction of the lunar tide in longitude would entirely cease, whilst that in latitude would have no effect upon the earth's axial rotation. At this point Mr. Garbett asserts that the maximum retardation would be attained; but, in arriving at this conclusion, he overlooks the fact that a monthly solar tide equal to two-fifths of the lunar one would still exist and exert a retarding influence upon the now monthly rotation of the earth. In other words, and in accordance with his own simile, the earth not only rubs against the moon, but also against the sun. Now, as soon as this further retardation commenced, it would of course again set in motion a lunar tide, which, acting in an opposite direction, would tend to neutralise the effect of the solar tide. But the friction of these two tides would clearly be dependent upon the velocity of each wave as well as upon its height, and it is evident that, although the altitude of the lunar wave would be more than twice that of the solar one, yet its velocity would, for a long time, be much smaller. Consequently, the friction of the solar wave would be greatly in excess of that caused by the lunar one, and the retardation would therefore still proceed until the friction of the two tidal waves became exactly equal. At what period such equality would be attained I am not prepared to say, but it would obviously be produced by some rate of axial rotation between a monthly and an annual one. Thus there can be no doubt that, under the conditions contemplated, the retardation would not stop at a monthly revolution, as stated by Mr. Garbett, but would go on until a considerably slower rate was arrived at. I am also of opinion that other circumstances would prevent the friction of the solar tide from being perfectly neutralised until an annual axial rotation of the earth was established; but, as I am not at present prepared to state the arguments upon which this opinion is based, I do not now insist upon it. Mr. Garbett further objects to my assuming that the terrestrial ocean would not be engulphed before it had effected by its friction the contemplated retardation of the earth's axial motion. In a case like this, where two catastrophes are approaching at an inconceivably slow and altogether unknown rate, it is obviously impossible to calculate with certainty the prior advent of either; but, in accordance with the supposition upon which I was speaking at the close of my lecture—viz., that the moon had encountered these catastrophes in the order indicated —I can see no *à priori* reason why they should not occur to the earth in the same order. In conclusion, I beg to say that the latter portion of my discourse was of a purely suggestive and speculative character, and was by no means intended as a formal exposition of the cosmical events mentioned therein."

The Abbé Moigno's translation of Professor Tyndall's "Heat as a Mode of Motion" is announced in Paris.

M. Maumene has written a memoir entitled "Theorie Générale de l'Exercice de l'Affinité." By the help of this theory he is enabled to calculate *à priori* the results of the action of sulphuric acid upon metals and metalloids; also to determine the conditions of the formation of ammonia from nitric acid, &c., to explain the phenomena of the precipitation of metals by one another from their saline solutions, to analyse a great number of the phenomena of organic chemistry, and, in fact, to calculate all the results of the chemical action between a solid and a liquid, or between two liquids incapable of mixture. If this theory be really correct, a great step will have been made, and chemistry will rapidly become a mathematical science.

A Dispute has been for some time carried on in the *Journal fur Gasbeleuchtung* between Professor Mulder, of Utrecht, and several other chemists, as to the danger of using, in the manufacture of gas, coals which have been injured by sea water. Some time back, it appears, a purifier at the Utrecht gas works exploded, and Professor Mulder accounted for it by suggesting that the pipes had become stopped by chloride of calcium, which, he supposed, had been formed owing to the presence of salt in the coal. He says that when coals have absorbed such a quantity of sea water that 10,000 lbs. of coal contain 7 lbs. of salt, the chlorine combines with the lime and forms chloride of calcium. The professor alleges such to have been the cause of the accident in question, but this view is opposed by several chemists practically acquainted with the subject.

ANSWERS TO CORRESPONDENTS.

J. Bungate will receive an answer by post.

Dr. Attfield's letter shall appear in our next.

C. S.—Aniline will dissolve fats and oils to any extent.

J. A.—You will find a very good account in Nichol's "Cyclopaedia of the Physical Sciences."

A Subscriber.—We are not certain that the patent has yet been published, but we shall shortly give an account of some experiments with the process.

Enquirer.—Graham's paper will be found in the *Philosophical Transactions* for 1862; but you will find an account of dialysis in many books. Dr. Odling's lecture in Vol. V. of the CHEMICAL NEWS is an excellent account.

Book Received.—"Percy's Metallurgy—Iron and Steel."

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Atomicity of Oxygen, Sulphur, Selenium, and Tellurium,* *by M.* NAQUET.

On the Atomicity of Elements,* *by M.* KEKULÉ.

M. NAQUET starts with the question—Have simple bodies and compound radicals an invariable atomicity, or have they at the same time several atomicities?

The question, he says, appears to be one of words rather than facts. If by atomicity we understand merely the substitutional value of a body, without taking into account the degree of saturation of the compounds formed, then it is certain that bodies have several atomicities; but if we regard the atomicity of a body as its maximum capacity for saturation, then it is no less certain that the atomicity of a body is invariable.

Until now it has been admitted that sulphur, selenium, and tellurium have an atomicity equal to two, and it is a fact that, in the largest number of their compounds, they are substituted for, or combined with, two atoms of hydrogen or some other monatomic radical; but there are bodies into which sulphur, selenium, and tellurium enter with a substitutional value equal to four. We must say, then, that these bodies are either bi- or tetra-atomic, or tetra-atomic only, just as we accept one or the other definitions of atomicity given above,

The researches of M. Carius have shown that there probably exists a chloride of sulphur, having the formula SCl_4, ($S = 32$. $Se = 79\cdot5$. $Te = 129$,) and we have long known a chloride of selenium and a chloride of tellurium which, by the action of water, are transformed into selenious and tellurous acids without the deposition of either of the metalloids. These are definite compounds, answering to the formulæ $SeCl_4$ and $TeCl_4$. Further, tellurium forms similar compounds with bromine, iodine, and fluorine. The last has never been analysed, and its composition is only inferred from analogy.

M. Naquet, therefore, regards the tetra-atomicity of sulphur, selenium, and tellurium as *established*, and goes on to give reasons for believing oxygen also to be tetra-atomic.

M. Kekulé thinks it his duty to reply to M. Naquet, since he believes that he first introduced into chemistry the idea of the atomicity of elements. He therefore explains as concisely as possible some of the fundamental ideas of the theory. We have known a long time, he says, that elementary bodies combine according to the law of constant proportions and the law of multiple proportions. The first of these laws is perfectly explained in the atomic theory of Dalton; the same theory only explains the second law in a general and vague way. What Dalton's theory does not explain is, why the atoms of different elements combine in certain proportions rather than in others. I have endeavoured to explain the whole of the facts by what I have called the *atomicity of elements*.

The theory of atomicity is therefore a modification of the atomic theory of Dalton, and according to my idea, atomicity is a fundamental property of the element, a property which must be constant and invariable, like the weight of the atom itself. To allow that the atomicity may vary, and that one and the same element may act sometimes with one atomicity and sometimes with another, is to apply the word in a sense quite different from that I intended when I proposed it; it is to confound the idea of atomicity with that of equivalence. Nobody now doubts that one and the same body, even elementary, is capable of acting with different equivalents. The equivalent may vary, but not the atomicity. The variation of the equivalent must, on the contrary, be explained by the atomicity.

A second confusion has arisen from the definition which it has been attempted to give to atomicity. Instead of choosing among the different possible senses, that which explains it in the simplest and most complete manner, atomicity has been defined as *the maximum equivalent* or the *maximum capacity for saturation*. If this definition be admitted it follows that we must consider as pentatomic, elements which I have regarded as triatomic, such as N, P, Sb, As, Bi. The same idea has led M. Naquet to regard as tetra-atomic the elements Θ, S, Se, *Te*, which we have hitherto looked on as biatomic. It must also lead us to suppose iodine triatomic, as well as other bodies, chlorine and bromine, which we now take for monatomic.

In fact, if the existence of the compounds NH_4Cl and PCl_5 demonstrates that nitrogen and phosphorus are pentatomic; if the substances quoted by M. Naquet (SCl_4 &c." establish that sulphur, selenium, and tellurium are tetra-atomic, we must conclude that the existence of the compound ICl_3 proves that iodine is triatomic.

Such reasoning need not be met with arguments; it reduces itself to absurdity. In effect, the triatomicity of iodine being in this way *established*, it is only necessary to look at the compounds PI_3 and TeI_4 to be convinced that phosphorus is nonatomic, and that the atomicity of tellurium is equal to 12. Further than this, chlorine having evidently the same atomicity as iodine, *i.e.*, triatomic, the existence of the compound ICl_3 proves that iodine is no longer triatomic, but nonatomic and so on.

M. Kekulé then goes on to give a succinct *resumé* of his ideas on the subject of atomicity; but for this we have not space this week.

TECHNICAL CHEMISTRY.

The Chemical Constitution of Pig-Iron.†

HERR RAMMELSBERG has recently investigated the views of Karsten and Gurlt on the chemical constitution of pig-iron (*see* Erdmann's *Jour. f. pr. Chem.*, Bd. 89, S. 393) and has arrived at essentially different conclusions. According to Karsten, white and grey iron are chemical combinations of carbon with iron—the grey iron containing, at the same time, an admixture of graphite. This remains unchanged on the iron being dissolved in acids; while the chemically combined carbon —particularly with concentrated acids—is changed into a strongly odoriferous oil-like combination, the greater part of which volatilises in the hydrogen, only a small portion dissolving in the acid. According to their views, Spiegeleisen is a chemical combination of iron with the maximum amount of carbon, 5 to 6 per cent., but containing no graphite.

Rammelsberg, on the contrary, has found 1·61 per cent. of graphite in the Müsen Spiegeleisen; and Bromeis, before him, found graphite in the white pig-iron of Mägdesprung, as will be seen by the following analysis:—

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* Abridged from *Comptes-Rendus*, t. lviii., pp. 381, 510.

† *Poggendorff's Annalen*, Bd. 120, S. 51.

	Carbon in Combination. Per cent.	Graphite. Per cent.	Total. Per cent.
Bright white pig-iron .	2·518	0·500	3·018
Grey pig-iron . .	2·908	0·550	3·458
Spiegeleisen . .	3·100	0·72	3·820

As, according to Rammelsberg, the Mägdesprung Spiegeleisen only contains 3·9 per cent. of carbon, it seems that this class of iron may contain very unequal quantities of carbon, as well as an admixture of graphite, without any change in its character or properties. It might have been supposed that other metalloids replaced carbon—for example, silicon; but the analyses show, on the contrary, that the iron richest in carbon was also richest in silicon. In the Müsen Spiegeleisen there was found 1·5 per cent. of silicon, in that of Mägdesprung 0·17, and in that of Styria from 0·01 to 0·27 per cent.—the latter only containing from 3·75 to 4·14 per cent. of carbon.

According to Gurlt, Spiegeleisen is a fourth carbide, and octahedric crystalline grey pig-iron an eighth carbide; the phosphorus, sulphur, and silicon being isomorphous with the carbon, and the manganese with the iron. But if in stating the atomic ratio between the electro-positive and the electro-negative constituents of the Spiegeleisen of Müsen and Mägdesprung we adopt Rammelsberg's view, we have a ratio of 1 : 4·5 and 1 : 5·3 instead of 1 : 4. The grey octahedric crystals (the eighth carbide of Gurlt, approximating to wrought iron according to Tunner) are found to be very variable in composition, as shown by the following analysis:—

	From Rothehütte. By Rammelsberg.	From Lauchhammer. By Rammelsberg.	From Gleiwitz. By Gurlt.	From Lölling. By Richter.
Graphite .	2·604	2·519	2·84	2·122
Carbon . .	0·201	0·373	2·46	0·967
Silicon . .	1·896	1·148	0·26	0·972
Phosphorus .	0·065	0·406	?	0·021
Sulphur . .	0·069	0·043	?	0·008
Arsenic . .	—	—	—	0·005
Atomic ratio .	1 : 19	1 : 21	1 : 8	12·5

Therefore, there are generally more than eight atoms of iron to one atom of carbon (silicon, phosphorus).

It will thus be seen that white as well as grey pig-iron may crystallise under favourable circumstances, without the formation of the crystals being disturbed by the embedded graphite. The variation in the composition of the crystals, shown by the above analyses—taking place without any alteration in the crystalline form—can only be accounted for by the isomorphism of the elements; and according to Rammelsberg, such is the only possible explanation of the constitution of pig-iron. As all the essential constituents of pig-iron—such as iron, silicon, phosphorus, and carbon (as diamond)—crystallise on the regular system, and are consequently all isomorphous, we may consider pig-iron as an isomorphous mixture of its constituents, which will explain the variation of its composition.

There are many examples of metals belonging to the regular system which form alloys that again crystallise on the same system; but there are also many alloys which crystallise on this system, whose constituent metals belong to distinct crystalline systems. On the other hand, metals that crystallise on the regular system form alloys crystallising on a different system; thus, for example, silver, zinc, nickel, and copper (iron), alloyed with antimony, crystallise on the pyramidal system. If, therefore, Spiegeleisen is pyramidal, as is probably the case, it belongs to this class of isomorphous mixtures; and the difference of form in grey and white pig-iron results from the heteromorphism of their isomorphous constituents. This heteromorphism is evidently a general characteristic of the elements, being just as marked in the metals as in sulphur and carbon. Doubtless the rhombohedric metals—Sb, As, Fe, Bi, Zn, Pd, Ir, and Rd—and the tetragonal Sn, isomorphous to Bo, may, under certain circumstances, crystallise on the regular system; while Au, Ag, Cu, Pb, &c., and also Sn, may be rhombohedric.—*Mining Journal.*

PHYSICAL SCIENCE.

On the Indices of Refraction of Frauenhofer's Lines, by M. Van der WILLIGEN.

THE following extract from the *Comptes Rendus de l'Academie*, des Pays-Bas, gives the indices of refraction of twelve rays of the solar spectrum for distilled water. $\bar{G}$ and $\bar{H}$ are two intermediate rays between F and G and G and H, which I have added to those already marked—that is to say, to ten of Fraunhofer. $\bar{G}$ indicates that this ray is situated above G; I do not think it desirable to introduce new letters for these rays on account of the confusion which might result.

The columns I and II differ the one from the other by the inversion of the lateral plates which closed the prism, so as to eliminate the defects of parallelism of the surface of these glasses.

These glasses were prisms of an angle of two to three minutes, which I measured.

I have introduced the necessary corrections, and the combination of columns I. and II. in the third ought to do away with the small faults which may still remain.

The instrument I used is a spectrometre of Meyerstein, of Göettingue, which, with the aid of microscopes, gives the angles to a second.

The fifth column gives Fraunhofer's numbers.

The sixth column shows that these numbers are rather higher than mine, which seems to indicate that the water Fraunhofer used was neither distilled nor sufficiently pure.

This increasing difference between Fraunhofer and myself does not disturb me, for the same impurity which produces our general difference may also produce increasing difference in the dispersion more than adequate to account for this successive augmentation of differences.

The variation by degrees of temperature, shown at the bottom of the table, is deducted from the total variation for 9°·8 taken from the two positions I. and II., for each of these columns is the mean of two others obtained at different temperatures; and the differences between the two fundamental series of each column combined gave the value 6·03. On multiplying it by 5·8, 35 is obtained, which shows that the mean difference between the columns I. and II. may be explained by the difference of temperature, and indicates the preciseness of the corrections applied to these columns; that is to say, for the exactness of the values given to the angles of the prisms formed by the glasses, which ought to have parallel faces.

The water was not freed from air, for it seems to me impossible that it could have remained pure during these observations.

I hope soon to complete a more extended memoir on the indices of the refraction of water and of mixtures of water and sulphuric acid, of which this extract is but the preamble:—

	Temperature. 22°·37 C. I.	Temperature. 16°·58 C. II.	Temperature. 19°·5 C. Mean.	Temperature.	18°·750 Fraunhofer.	Difference.
A.	1·32876	1·32921	1·32899	19·4	—	—
a.	1·32966	1·33000	1·32881	19·4	—	—
B.	1·33031	1·33064	1·33048	19·4	1.330956	48
C.	1·33101	1·33142	1.33122	19·5	1·331710	49
D.	1·33282	1·33332	1·33307	19·5	1·333577	51
E.	1·33502	1·33553	1·33527	19·5	1·335850	58
b.	1·33541	1·33589	1·33565	19·5	—	—
F.	1·33698	1·33741	1·33720	19·5	1·337803	60
G̅.	1·33880	1·33923	1·33901	20·0	—	—
G.	1·34049	1·34077	1·34063	19·5	1·341279	65
H̅.	1·34223	1·34245	1·34234	19·5	—	—
H.	1·34338	1·34361	1·34350	19·5	1·544170	67

Variation for one degree of temperature = 6·03. Difference of temperature I. and II. = 5°·8. 5·8 × 6·03 = 35. —*Les Mondes*, 395, 63.

PHOTOGRAPHY.

On Celestial Photography in America, by Professor Henry Draper, *M.D., New York University.*

The first photographs of the moon were taken in 1840 by my father, Professor John W. Draper, M.D., who published notices of them in his quarto work, "On the Forces that Organise Plants," and in the *Philosophical Magazine*. The specimens were about an inch in diameter, and were presented to the Lyceum of Natural History of New York. They were made by means of a lens of five inches aperture, furnished with an eye-piece to increase the magnifying power, and mounted on a polar axis driven by a clock. At that time it was generally supposed that the moon's light contained no actinic rays, and was entirely without effect on the sensitive silver compounds used in daguerreotyping.

In 1850 Mr. Bond made use of the Cambridge (Massachusetts) refractor of fifteen inches' aperture, to produce daguerreotype impressions of our satellite, the sensitive plate being placed at the focus of the object-glass, without the intervention of an eye-piece. Pictures two inches in diameter were thus produced, and subsequently some of the same size were made on glass, and mounted stereoscopically. Mr. Bond also made a series of experiments to determine whether photography could be advantageously applied to the measurement of double stars, and concluded that the results were as reliable as those derived from the micrometer.*

Soon after, Mr. Warren De La Rue, of Cranford, near London, undertook, by the aid of a thirteen-inch speculum, ground and polished by himself, to produce a series of photographs of the moon and other celestial objects. The excellent results that he has obtained, together with those of Professor Phillips, Mr. Hartnup, Mr. Crookes, Father Secchi, and other physicists, are doubtless familiar to all scientific men, having been published in the form of a report to the British Association in 1859. No detailed description of them is necessary, therefore, in this place.

In 1857 Mr. Lewis M. Rutherfurd, of New York, erected an equatorial refractor of eleven inches' aperture, the object glass of which he had himself corrected, and has taken a large number of lunar photographs with it. They have generally borne to be magnified to five inches, and he is now engaged in perfecting a correcting lens that will allow still greater enlargement to be used.

The moon, as seen by the naked eye, is about one-tenth of an inch in diameter, although persons generally estimate it at ten inches. That the first statement is true is easily proved either by taking a photograph with a lens of ten inches' focal length, or more convincingly by holding up between the moon and the eye a little disc one-tenth of an inch across, at the nearest distance of distinct vision (ten inches). A picture of the moon of the size commonly attributed to her requires to be made under a power of 100 times.

In 1859 I visited Lord Rosse's great reflecting telescopes at Parsonstown, and had an opportunity of not only seeing the grinding and polishing operation by which they were produced, but also of observing some stars through the six-foot instrument. On returning home in 1858 it was determined to construct a large instrument by similar means, and devote it especially to celestial photography. The speculum was of fifteen inches' aperture, and twelve feet focal length. Subsequently, however, this metal mirror was abandoned, and silvered glass, as suggested by M. Foucault, substituted. This latter, according to Steinheil's experiments, reflects more than 90 per cent. of the light falling upon it, while speculum metal only returns 63 per cent. A detailed account of this instrument, amply illustrated, is now being published by the Smithsonian Institution at Washington, and therefore only a general idea of its peculiarities will be given.

As the telescope was intended especially for photography, the following general principles were adopted:—1st. A reflector was, of course, preferred to an achromatic object glass, because all the rays falling upon it are reflected to the same focal plane, and there is not, as in the latter, one focus for distinct vision, and another for the photographically actinic rays, an inch distant perhaps. In the reflector, a sensitive plate put where the image is seen to be most sharply defined will be sure to give a good result. In the achromatic, on the contrary, the sensitive plate must be placed in a position which can only be found by tedious trials. 2nd. Silvered glass was used instead of speculum metal because it is lighter and more highly reflecting. Besides, if a reddish or yellowish film should accumulate on it—an accident liable to occur to either kind of reflector, and seriously diminishing the photographic power—it can either be repolished with a piece of buckskin—an operation obviously impossible in the case of a speculum metal—or the silver can be dissolved off with nitric acid, and a new film deposited on the glass concave. The glass, which has been made accurately parabolic before the first silvering, is not changed in figure, the silver being only deposited in a layer $\frac{1}{300000}$th of an inch thick, and consequently, if carefully prepared, copying the glass below so closely that no error larger than a small fraction of that amount is possible. As the glass only serves as a basis or mould for the thin sheet of silver, and is not penetrated by the light, its quality is a matter of but little moment, that which is used for skylights or light-openings in floors answering perfectly. 3rd. A mounting presenting the greatest degree of steadiness possible was necessary. For this purpose the telescope was supported at both ends, the lower one resting in a loop of wire rope. 4th. Instead of driving the whole mass of the instrument by clockwork acting upon a polar axis, and thus being forced to move a weight of at least half-a-ton—the usual system in equatorials—only the sensitive plate and its frame, weighing an ounce, were caused to follow the moon or other object, the mass of the apparatus remaining perfectly at rest. This idea is due to Lord Rosse. 5th. Instead of using a clock with wheo work for a prime mover, a *clepsydra* was substituted. This consists of a heavy weight supported by the rod of a piston, which fits into a cylinder filled with water. At the bottom of the cylinder a stopcock permits the water to flow out at a variable speed, depending on the amount of opening. The sensitive plate can thus easily be caused to coincide in rate with the moving object, and yet by a motion free from irregularity and tremor.

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* "Astron. Nach," No. 1129.

The value of a silver reflector turns, of course, entirely upon the perfection of the glass concave on which the metallic film is to be deposited. This must be of a parabolic figure, so that spherical aberration may be completely corrected. A person is, however, content to take the utmost pains to produce it, because, once attained, the figure cannot be lost except by fracture, and the value does not diminish with time, as in the case of a speculum. It never requires re-polishing. The best method of grinding and polishing the glass is by means of an apparatus that I have called a "Local-correcting Machine," by which all the parts of the surface can be attacked in succession and reduced to the desired curvature, and yet at the same time a uniform curve and absence of local irregularities secured. I have spent five years in the investigation of this subject, and have polished more than 100 mirrors of from nineteen inches to one-fourth of an inch in diameter on seven different machines built at various times. The quality of those I have at present is indicated by the fact that they will show *Debillisima* to be quintuple, and will render the close companion of Sirius, discovered by Alvan Clark's magnificent eighteen and a-half inch refractor, visible.

The Observatory at Hastings-upon-Hudson, near New York, lat. 40° 59′ 25″ N., long. 73° 52′ 25″ W. of Greenwich, is upon the summit of a hill 225 feet above low-water mark. It is twenty feet square, with a wing 9 × 10 for a photographic laboratory. As the telescope is a Newtonian, with the mounting so contrived as to have the eyepiece stationary at all altitudes, a plan originally suggested by Miss Herschel, there are peculiar facilities offered for easy access to the eyepiece, or place of the sensitive plate. The interior height of the Observatory, twenty-two feet, is divided into two stories, around the upper of which an observer's chair runs to follow the telescope. The dome turns upon a pivot at its centre, instead of on rollers or cannon-balls around the edge, and is moved consequently with but slight exertion.

Since the telescope has been completed, and furnished with two parabolic mirrors of fifteen and a-half inches' aperture, and 150 inches' focal length, and one Herschelian mirror (that is, a concave of such figure that it can only bring oblique pencils to a focus free from aberration), celestial photography has been continually prosecuted. About 1500 lunar negatives have been taken. Old experience obtained from portrait and microscopic photography has proved to be of great service. At first the well-known processes were used, but it was soon found that something more refined was needed, where the pictures are to be submitted to magnifying powers of perhaps twenty-five times. Defects in collodion negatives that would, under ordinary circumstances, pass unnoticed, assume such prominence as greatly to diminish the beauty of the results. These defects, pin-holes, coarse granular appearance of the reduced silver, and other markings were found to arise principally from the presence of nitrate of silver on the sensitive plate. It was ascertained that by washing the plate thoroughly before exposure they disappeared, or were very much ameliorated, and without any reduction in sensitiveness. But for this washing operation pure water is needed, and hence the roof of the buildings was painted with a ground mineral compound that hardens to a stony consistence, and the water falling upon it was preserved in a leaden tank, which, from long use for other purposes, had become thickly coated with insoluble salts of lead, sulphates, &c. Whenever an inch of rain falls, a ton of water is collected, and the tank may be filled about thirty-two times in a year.

The negatives produced at the focus of the reflector are on an average $1\frac{4}{10}$ inches in diameter. Many that have been made will bear to be enlarged to two feet, and one was taken September 3, 1863, at 4.30 a.m., which has been increased to three feet in diameter, the total magnifying power used being about 380. In this photograph the moon may be said to be shown on a scale of sixty miles to the inch.

In the process of enlarging I have introduced one very important novelty. Instead of employing an achromatic combination of lenses arranged as a solar camera, a concave mirror is used. It entirely gets rid of the difficulty of chromatic aberration, which is, as all photographers know, one of the most serious obstacles to success, and, in addition, the magnified image lies in one plane, or there is what is termed a flat field. Every little detail of the original negative is perfectly reproduced, and a three-foot image is as sharp in one part as in another. The effect of portraits reproduced of life-size is very striking, and the resemblence to the individual singularly increased. In magnifying these lunar negatives, a mirror of eight inches' aperture and eleven and a-half inches' focal length is used. At first, when it was intended to employ diffused daylight and the whole aperture, the figure was made elliptical, with a distance of eight feet between the conjugate foci; but subsequently, when the advantages of sunlight were understood, the surface was reduced by a diaphragm to a little more than an inch in diameter, and a part of the mirror as nearly perfect as a mirror can be made at present was selected. Success in enlargement becomes with this contrivance a certainty.

The "enlarger" is also equally valuable in copying by contact. When a small negative is enlarged and photographed, what is termed a positive results. If such a positive is used to make prints on paper, the lights and shades are inverted, and that which is white is shown black. It is necessary then to turn the original negative into a positive, so that when magnified a negative may result suitable for printing positive proofs on paper. This is done usually by a process called reversing, in which a sensitive plate is placed behind the original negative, and the two exposed to the light. Wherever the negative is transparent the plate behind is stained by the light, and where opaque it is protected. But unless the plate behind is so close as to make the chances of scratching the negative very great, the positive produced is much inferior in distinctness, because the diffused light of day finds its way through in many directions. If, however, the negative and sensitive plate are placed in the beam of sunlight coming from the enlarger, the rays pass through only in one direction, and the reverse or positive is as sharp as the original negative.

Celestial photography is as yet only in its infancy. The results to which it has given origin, although excellent in many respects, have imperfections. But it seems probable that these may be overcome in the future, partly by means now within reach, and partly by others which may be discovered at any moment. In looking at a three-foot photograph from such a distance that the eye can embrace it all at one glance, the general effect is certainly very fine, and superior to observation through the telescope with a similar power. The moon appears as it would if viewed from a stand-point 600 miles from its surface. Ranges of mountains, as the Apennines, seem as if projected out from the general level, while the great craters, such as Plato, Theophilus, and Clavius, are deeply excavated below. Grooves of vast extent, like those diverging from Tycho, and faults such as that running past Kant and Catharina on the one side, and Tacitus on the other towards Lindenau, still further break up the surface. The well-known seas and bright portions, so distinct to the naked eye, are lost in the multiplicity of the details into which they are resolved.

But coming more closely to the picture, and examining with a critical eye, it is apparent that, although the general effect is the same as would be perceived by looking at the moon itself, yet some of the minute details seen in the telescope with a high power are absent.

The reasons which lie at the bottom of this difficulty are connected to a certain degree with the photographic processes employed, but also to not a little extent with the condition of the air. The quality of the instrumental means used is, of course, of primary importance. A good photograph cannot be taken with an inferior telescope and clock.

The obstacles arising from photography result from the fact that the dark parts of the picture are not formed by a continuous sheet of material, but by an aggregation of granules which, though invisible to the unassisted eye, are seen when a high-enough magnifying power is employed. Their degree of visibility turns on the system of development used for bringing out the latent image on the sensitive plate. A picture injudiciously forced with pyrogallic acid will hardly bear any enlargement, though one made with sulphate of iron and a well-regulated exposure may be increased in diameter twenty-five times, without showing the granulations offensively. The influence of the structure of the collodion-film itself, too, is noticeable in pictures taken by the wet process; in the first place, being somewhat transparent, it permits a certain amount of lateral diffusion in the film, and a tendency to soften down the more minute details; and, in the second place, while wet it has quite a perceptible thickness, which is much diminished in drying, and the relation of the silver particles to one another changed.

I have attempted to avoid the faults connected with structure of the film by substituting dry collodion, and more particularly tannin plates for the wet. But though during the exposure to the celestial object the sensitive plate presents a glassy surface of extreme thinness, yet an indispensable preliminary to evoking the latent image is to soak the plate in water, and this introduces the more injurious of the two objections above urged. It was while trying this process that I ascertained the advantages that arise from warming the film during development,—the "hot-water process," as it is called. The attempt was also made to daguerreotype the original pictures at the focus of the telescope on silver plating, and also on silvered glass. In this case all lateral diffusion is entirely prevented, the light acting on a mathematical surface, and the relations of the film of silver to the glass not being disturbed by the subsequent manœuvres. But practically no advantage has arisen from these trials, because, as in the former instance, the whites in the resulting picture are not formed by a continuous stratum of mercurial amalgam. That this is the case is proved by the fact that such daguerreotypes can be copied by the electrotype, or a coating of isinglass, as was shown by Dr. Draper (*Philosophical Magazine*, May 1843). This is the first occasion on which silvered glass has been used for photographic purposes, and it may be well to point out its advantages. Owing probably to the perfect purity of the silver, it takes the coatings of iodine and bromine with uniformity all over; in silver plated by fire on copper, there used to be a tendency to insensitive spots, from the copper alloy coming out on the face of the silver, and so great was the annoyance, that, when my father was engaged in the experiments that led him to take the first portrait ever obtained from life, he was compelled to use sheets of pure silver alone. The light also seems to be able to impress the iodo-bromide in less time, and pictures of a rosy warmth are generally obtained. The only precaution necessary in practising this method of daguerreotyping is to fix the plate—that is, dissolve off the excess of sensitive material—with an alcoholic solution of cyanide of potassium, instead of an aqueous solution of hyposulphite of soda. The latter tends to split up the film of silver from the glass here and there, while the former does not. The subsequent washing, too, is most safely conducted with diluted common alcohol. The time of exposure is not, however, as short as in the wet collodion process, at least six times the exposure being demanded; while if less is given, and the development over mercurial vapour be urged beyond the usual point, minute globules of mercury stud the silver all over, and ruin the proof.

The faults arising from atmospheric disturbances are easily understood. If an image of the planet Jupiter produced by a large telescope be allowed to move across a sensitive plate, and the plate be then developed, a dark streak nearly of the width of the image will appear. If this streak is closely examined, it will be observed that the passage of the planet seems to have taken place in an irregular way—by fits and starts as it were, and that instead of the mark being continuous like that of a pencil, it rather resembles a string of beads. The cause of this lack of continuity is to be found in the movements of the earth's atmosphere. Or, if the eye is placed at the eyepiece of the telescope, and the edge of a planet or the moon watched, it is found to present a wavy outline instead of a sharp disc-like appearance. Any point in the surface, too, is seen to have a rapid vibratory motion.

Although the eye can emancipate itself to a certain extent from these disturbances, a photographic plate cannot. Every point tends then to assume a greater size and less distinctness than it should have, and if the night on which the trials are being made is very unsteady, the smaller details are so confused together that the picture is worthless. Occasionally, however, very still nights occur, when photographs of great beauty may be taken. In the interval between March and December, 1863, three such nights occurred, and on one of them the negative for the three-foot was obtained.

It has been stated that there are no insuperable obstacles to the production of perfect celestial photographs,—that is, such as realise the full optical power of the telescope used. The atmospheric difficulty may be successfully combated by removing a large reflector from near the level of the sea to a considerable altitude, where a great part of the atmosphere is left behind. It seems to me that a suitable place for such a purpose would be the rainless west coast of South America, somewhere near the equator. Improvements, too, are continually being invented in photographic processes, and a considerable step is made when we find out what it is that we need. Quick methods are not so much required as those which will yield grainless pictures on structureless films, and unless the time of exposure could be so much shortened as to be but a small fraction of a single atmospheric pulsation, no particular advantage would be gained by their use.

The inducements to amateurs to prosecute the study of celestial photography are very great, and the apparatus required is such as any one of a mechanical turn may make. A great deal can and will be done in this branch of astronomy; and animated by the hope that many others may be induced to cultivate it, I have written the detailed account in the Smithsonian Contributions.—From the *Quarterly Journal of Science*, No. 2, April, 1864.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 17, 1864.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

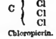
The business of the evening commenced as usual by the reading of the minute book; after which Dr. Thomas Stevenson and Mr. Williams were formally admitted by the President, and the Society proceeded to ballot for Mr. Thomas L. G. Bell, of Victoria Docks, and Mr. Benjamin Charles Staples, of London, both of whom were duly elected Fellows of the Society.

The President then said he regretted to have to announce that the Society would not be favoured that evening with the presence of Sir Benjamin Brodie, who had promised to address them on a theoretical subject of great interest. He was informed a day or two since that Professor Brodie had met with an accident during the preparation of some peroxide of acetyl which he required for the purpose of illustrating his lecture. A glass apparatus containing the material exploded in his hand, and the fragments had cut his face a good deal and slightly injured one of the eyes. That day he had again received word from Oxford by telegraph which enabled him to assure the meeting that the injuries Professor Brodie had sustained were but of a temporary nature, and would not be likely to interfere with his intention of addressing them, although that occasion must be deferred for a few weeks. By way of providing for this emergency, Dr. Hofmann had, in the kindest manner, and at very short notice, come to their aid, and a paper by Mr. Mills, of Glasgow, would also be read.

The Secretary then proceeded to read a communication "*On Nitro-Compounds*," by Edmund J. Mills, Esq., B.Sc. The object of the investigation (Part I. only of which is completed) was to establish, if possible, a more satisfactory basis for the classification of nitro-compounds than any yet existing; and for this purpose the author had conceived and carried out the idea of watching the effect of one and the same reducing agent, under as uniform circumstances as possible, upon several typical nitro-compounds. Hydriodic acid was the reducing agent employed, and it was made to act upon (1) chloropicrin, which under its influence furnished ammonia, hydrochloric acid, and carbonic anhydride. (2) Marignac's oil treated in the same manner gave ammonia, nitric oxide, and, as before, hydrochloric acid and carbonic anhydride. Comparing the formulæ of these bodies (both on the marsh gas type),

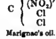
$$C\begin{cases}H\\H\\H\\H\end{cases}$$

Marsh gas.



$$C\begin{cases}(NO_2)'\\Cl\\Cl\\Cl\end{cases}$$

Chloropicrin.



$$C\begin{cases}(NO_2)'\\(NO_2)'\\Cl\\Cl\end{cases}$$

Marignac's oil.

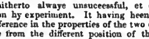
and bearing in mind their extraordinary resemblance in all points, one would naturally expect the (NO_2) to be converted into the same product in each case; but the author found that only one (NO_2) in Marignac's oil resembled the (NO_2) in chloropicrin by yielding ammonia, the other must be different from it, for it became converted into nitric oxide. Hence there were two kinds of NO_2, or "nitryl."

The Author remarked at this point, that when nitric oxide was eliminated in the presence of hydriodic acid, part of it was converted into nitrous oxide, so that in this respect there was some resemblance between HI and H_2S. Proceeding then to describe reactions with other bodies, it was stated that (3) dinitro-octylene $(C_8H_{14}(NO_2)_2)$ permitted *both* the molecules of nitryl to be transformed into *ammonia*, with regeneration of octylene; but the greater part of the octylene seems, at the moment of reproduction, to be converted into a black oil, the composition of which was doubtful, perhaps $C_8H_{16}HI$(?). (4.) α. Trinitroglycerin (the explosive variety) yielded glycerin and *nitric oxide*. (5.) Nitrobenzol yielded, of course, *aniline*,—interesting inasmuch as benzol is the marsh gas analogue in the aromatic group. (6.) Hex-nitro-mannite furnished mannite and *nitric oxide*, with a very small quantity of a by-product, becoming brown at 100° C. (7.) α and β nitraniline yielded, without a doubt, the hydriodates of the corresponding phenylene-diamines, but the confirmation of analysis was yet required before this could be positively asserted. A very interesting fact was mentioned in connexion with the nitranilines. It appeared that when equal weights of these compounds were treated in a precisely similar manner with hydriodic acid, and heated together in a sulphuric acid bath, that the bulb of the thermometer enclosed within the liquid in the glass tube became completely invisible from the separation of free iodine much earlier in the case of the alpha-nitraniline than in the other tube. The weaker the hydriodic acid, the higher is the temperature at which the complete obscuration takes place. Six comparisons, with full details, were given in the paper, and the author describes the degree of temperature at which the obscuration was observed to occur. This point, where the iodine separates, is termed the "attack-point" by Mr. Mills; and its determination promises to be of great assistance in solving the problem of nitro-compounds. If very strong or fuming hydriodic acid be used, the "attack-points" are undistinguishable; likewise, the acid must not contain free iodine, or exactly opposite results will be observed; indeed, Dr. Hofmann has stated that β phenylene-diamine is readily converted by oxidising agents into blue and violet colouring matters. In the last of these reactions with hydriodic acid the difference in the "attack-point" must of necessity indicate the existence of two kinds of nitryl, which view the author brings *à priori* argument to support. The important equations described under I. and III. were verified quantitatively, but Bunsen's method of determining free iodine would not succeed in the cases where nitric oxide was liberated from the nitro-compound. The author concludes by stating a general rule to the effect that any nitro-compound heated to 100° C. with hydriodic acid of sp. gr. 1·7, will have its "nitryl" converted into nitric oxide (NO), or into "nitrosyl" or amide (NH_2), and the substances may accordingly be classified as under:—

Amidogens.	Nitroso-amidogen.	Nitrosogens.
Chloropicrin.	Marignac's oil.	Nitric acid.
Dinitro-octylene.		αTrinitroglycerin.
Nitrobenzol.		βTrinitroglycerin(?)
αNitraniline.		Hexnitromannite.
βNitraniline.		

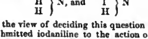
The President, in moving a vote of thanks to the author, said that, inasmuch as the subject was one which involved the adoption of new theories, he trusted there would be a full discussion upon the points raised by Mr. Mills.

Dr. **Hofmann** said that the remarkable isomerism of the alpha- and beta-nitranilines had frequently attracted his attention, and that from time to time he had made attempts, hitherto always unsuccessful, at elucidating this question by experiment. It having been suggested that the difference in the properties of the two compounds might arise from the different position of the complex atom NO_2 in the system, thus:—



$$\left.\begin{matrix}[C_6H_4\,(NO_2)]\\ H\\ H\end{matrix}\right\}N, \text{ and } \left.\begin{matrix}C_6H_5\\ (NO_2)\\ H\end{matrix}\right\}N$$

he had endeavoured to confirm or refute this view by ascertaining the number of ethyl atoms which the two compounds are capable of fixing under the influence of iodide of ethyl. Unfortunately, the ethylation of nitro-compounds presented obstacles which he had not been able to overcome. He might here mention that he had applied this process lately in another instance. Some years ago he had obtained an iodo-substitute of aniline, *iodaniline*, to the study of which he had been recalled by his researches on the colouring matters derived from aniline. Iodaniline corresponds in composition to chloraniline and bromaniline—$C_6\,(H_6Cl)\,N$, $C_6\,(H_6Br)\,N$, $C_6\,(H_6I)\,N$—but it differs essentially from these two substances in crystalline form. In his paper on Iodaniline, published in the Journal of the Society, he had found, in fact, the following passage:—"When I first obtained this compound, I expected to see it crystallise in octohedrons, an anticipation which appeared to be supported by the crystalline form of chloraniline and bromaniline, and the generally assumed isomorphism of chlorine, bromine, and iodine. But I have vainly searched the different crystallisations of iodaniline for octohedrons; from all the solutions which I tried iodaniline was invariably deposited in prismatic crystals; from a boiling aqueous solution it separates after some time in long, hair-like needles. The crystalline mass obtained by the solidification of the fused base likewise exhibits no cleavage of an octohedron." Now, when lately again preparing iodaniline, it struck him that this discrepancy in the crystalline form of bromaniline and iodaniline might be due to the bromine and iodine holding different positions in the two compounds, as indicated in the following formulæ:—

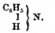


$$\left.\begin{matrix}(C_6H_4Br)\\ H\\ H\end{matrix}\right\}N, \text{ and } \left.\begin{matrix}C_6H_5\\ I\\ H\end{matrix}\right\}N$$

When, with the view of deciding this question by experiment, he submitted iodaniline to the action of iodide of ethyl, he was surprised to find a copious separation of iodine, the iodaniline being converted into a mixture of ethylaniline and diethylaniline, from which, by an additional treatment with iodide of ethyl, the iodide of triethyl-phenyl-ammonium was obtained. The latter he had identified by analysis. This result, although it did not finally settle the question at issue, appeared, nevertheless, worthy of remark. The coalescence of the two atoms of iodine (the one from the iodide of ethyl, the other from the iodaniline) into one molecule of free iodine would, he conceived, be water upon the mill of several gentlemen present.

The **President** pointed out the interest attached to this reaction as affording a new and striking illustration of the construction of the elementary molecules, to which the progress of science was unequivocally pointing, the iodine separating in this case as iodide of iodine.

Dr. **Hofmann** said that a similar, though less copious, separation of iodine took place when iodaniline was treated with hydriodic acid at 100°, aniline being at the same time reproduced. This reaction rendered the interpretation of the experiment previously mentioned somewhat doubtful; for although the formation from iodaniline of the iodides of ethyl-, diethyl-, and triethyl-phenyl-ammonium, would appear to prove that the radical phenyl existed intact in the original molecule of iodaniline, the separation of iodine from iodaniline by hydriodic acid suggested the possibility of the substitution for iodine of hydrogen from the hydriodic acid separated in the first stage of ethylation. Further experiments were, therefore, necessary for the final solution of the question, although there was no doubt left in his mind that iodaniline was represented by the formula



$$\left.\begin{matrix}C_6H_5\\ I\\ H\end{matrix}\right\}N.$$

In conclusion, Dr. Hofmann showed the facility with which a mixture of iodaniline and toluidine by mere application of heat was transformed into rosaniline. The product obtained by fusing a minute quantity of this mixture in a test-tube imparted a deep crimson coloration to a large quantity of alcohol.

Mr. W. H. **Perkin** considered that the influence of heat operated as the chief cause in inducing the remarkable differences between the properties of α and β nitraniline; for whilst the one was produced by the direct action of sulphide of ammonium upon dinitrobenzol, the other had to undergo five distinct operations in its preparation, which circumstance was likely to modify the properties and, to some extent, the constitution of the product.

Professor **Church** inquired of Dr. Odling whether there was not a foot note descriptive of the properties of β trinitroglycerin appended to Mr. Mills's paper?

Dr. **Odling** admitted there was one, which he now proceeded to read. It stated that in conformity with the observations of Professor Church alpha trinitroglycerin underwent a spontaneous change, which resulted in the formation of oxalic acid, the residual undecomposed substance becoming at the same time transformed into the beta modification, which no longer possessed explosive properties. The speaker suggested that a process of reduction might often be employed as a means of distinguishing between isomeric substances; in the case of these nitro compounds, it had been shown that the same chemical means sometimes reduced the nitryl to the condition of nitric oxide, and at other times still lower, even to ammonia.

Professor **Church** had been in communication with Mr. Mills upon the subject of trinitroglycerin. He had himself observed the separation of as much as four ounces of oxalic acid from about a pound of the original substance; there was a small quantity of regenerated glycerin formed, but the resulting beta compound was so destitute of explosive properties that it could be heated on a platinum spatule without any detonation ensuing.

The **President** announced that the balloting papers for the election of the Society's officers for the ensuing year were in the course of distribution; the meeting was then adjourned until the anniversary, on March 30.

PHARMACEUTICAL SOCIETY.

Wednesday, March 16.

Professor Redwood delivered his second lecture on the "British Pharmacopœia." This lecture was devoted to a review of the galenical preparations of the Pharmacopœia. The first noticed were the aquæ. After some remarks on the various processes given in the past Pharmacopœias for the preparations of those medicines, the lecturer said he believed that the compilers of the British had selected the best of the many methods which had been directed. One point worthy of notice, however, was that waters differed somewhat, according as they are distilled from still with a high or with a low head. Among the decoctions some alterations were noticeable. The decoction of bark was now directed to be strained when cold, by which the appearance would be considerably altered. In two cases, dec. aloes and dec. cinch., it was directed that water should be added after the boiling, to make the product up to a certain quantity, and it was to be regretted that similar directions were not given in every instance. When a decoction was ordered to be boiled for a certain time, the loss by evaporation depended on the shape of the vessel, and the quantities operated upon. In a wide and shallow vessel the loss was greater than in a deep and narrow one; and similarly, when the decoction was to be boiled down to a certain point, the time the materials were exposed to the heat would vary according to the shape of the vessel. The lecturer then referred at some length to the extracts and the different modes of evaporating. He expressed his opinion that, in most instances, the alterations in the modes of preparing this important class of medicines introduced into the British Pharmacopœia were decided improvements, particularly in the case of the extract. colch. acet., the ext. colch., and the extracts of green herbs. He noticed that the Pharmacopœia directs a water bath to be employed, the temperature of which would be about 200° F., and not steam heat, which, at a pressure of 10, 20, or 30 lbs., would be hot enough to destroy the extract at the last stage. He believed that evaporation *in vacuo* would be the best method, but it offered one difficulty: the contents of the pan could not be stirred, which was essential towards the end of the process. The infusions were next referred to. In these some of the changes were not for the better. Inf. calumbæ made with cold water contained no starch, but retained the albumen, which made it as liable to spoil as before. The root was now to be used coarsely powdered instead of sliced, which was a decidedly objectionable change. The new infusion of gentian the lecturer regarded as no improvement on the old. Among the liniments those of aconite and belladonna were noticed as new and efficient remedies. The new lin. hydrargyri introduced from the Dublin Pharmacopœia the Professor showed did not keep so well as the old London preparation. The spirits, it was observed, were all changed. They were no longer spirits in the old sense, but essences thirty or forty times stronger than the spirits in the London Pharmacopœia. Among the syrups the lecturer noticed the process for making syrupus papaveris, and remarked that, though an awkward process, it yielded a good product. The most important class of galenical preparations—the tinctures—were then referred to, and the omissions, errors, and inconsistencies in the directions for preparing these were severely criticised. We leave a detailed notice of these remarks to a future occasion. In the ointments some improvements were to be remarked; but in the case of lard it was to be regretted that the flare was not ordered to be well washed before it was cut up and the fat melted out.

The lecture was attended by a crowded audience, and elicited much applause.

CHEMICAL SOCIETY OF PARIS.

February 17.

M. Ad. Wurtz *in the Chair.*

M.M. Bnignet and Michaelson were elected, the first a resident, and the second a non-resident member.

At the request of the President, the Secretary read a letter from the Minister of Public Instruction respecting the recognition of the Society as an institution of public utility.

M. Le Blanc communicated a note from M. Pfeiffer "*On Rancid Butter.*"

M. Oppenheim mentioned some experiments showing that hydriodic acid when in aqueous solution is decomposed by ordinary or amorphous phosphorus, with production of the hydriodate of phosphuretted hydrogen.

M. Persoune reminded the members of a previous communication respecting the decomposition of water by phosphorus.

M. Guionet mentioned the formation of an amorphous blue deposit covered with mould, which had been formed in a solution of neutral tartrate of copper and potash.

M. Friedel, in the name of M. Crafts and himself, gave some particulars on the estimation of silicium in silicium ethyl by means of nitric acid, or of chlorate of potash and hydrochloric acid. He also gave an account of the action of bromine on silicium ethyl.

M. Personna made some observations on the method of estimating cinchonas, and pointed out that one variety of bark contained an alkaloid having the same equivalent as quinine, but differing in characters.

M. Baudrimont added some facts to those furnished by M. Personne.

M. Parsonne also mentioned that hydrocyanic acid might be preserved by the addition of a small quantity of an organic acid, such as formic acid.

M. Le Blanc said that M. Melsens had long employed oxalic acid for the same purpose.

M. De Luynes made some observations on the hydriodate of butylene. He described the products of the action of bromide, chlorine, alcoholic potash, and oxide of silver on this compound.

M. Baudrimont presented to the Society his memoir on the chlorides of phosphorus, written for the degree of Doctor of Science.

M. Dehérain presented the third volume of the *Annuaire Scientifique*, published with the assistance of many *savans*.

The Society has also received a number of the *Annuaire des engrais et des Amendements*, by M. Rohart.

ACADEMY OF SCIENCES.

March 21.

Some of our readers will be interested to know that a French geologist, M. Lartet, has recently explored some caverns in Syria, and found in the breccia which forms the floor bones of herbivorous animals and flint implements exactly like those found in Europe.

M. Ramon de Saora has sent to the Academy the results of the employment of sulphurous acid gas and phosphate and carbonate of ammonia in the defecation of sugar juice. The yield of crystallisable sugar is increased from 10 to 20 per cent.

M. Nickles made an interesting communication "*On the Chloro and Bromo-metallic Ethers of Thallium.*" We shall give this paper at length, but we notice at once the way in which the author obtains the chloro-metallic ether. He passes a current of chlorine into ether, standing upon either the metal thallium or the proto-chloride of the metal. The metal or salt gradually dissolves and the flask then only contains a limpid fluid. The ether is purified by heating it on a water bath in a current of carbonic acid. A good deal of hydrochloric acid gas is disengaged, and some other chlorinated products are removed. The metallic ether is not volatile. According to the author it has the composition

$$TlCl_3,2(C_4H_5O)HCl + 2HO.$$

Bromo-thallic ether $TlBr_3,3(C_4H_5O)$, shares most of the characters of the foregoing.

The existence of an *iodo-thallic ether* is doubtful.

M. Deschamps has submitted poppyheads to a long and careful examination, and now reports his results to the Academy. He states that he has found in the extracts of the capsules waxy matter, meconic, tartaric, citric, sulphuric, phosphoric, nitric, hydrochloric, and silicic acids, ammonia, morphia, sometimes a little narcotine, papaverin, and a very weak base, to which he has given the name papaverosine. In the ashes he found, in addition to those of the above-named acids which would be found there, lime, magnesia, potash, soda, iron, and manganese.

NOTICES OF BOOKS.

Address on Chemistry in its Relations to Medicine and its Collateral Sciences. By W. B. Herapath, M.D. Lond., &c., &c. Bristol: R. W. Smith. 1863.

This is the address delivered by Dr. Herapath at the annual meeting of the British Medical Association in August last, revised for general reading. It provoked some condemnation at the time in consequence of the author having gone somewhat out of his way to introduce topics which might as well have been omitted. In the revised state, parts are still obnoxious to criticism; but on the whole the address is eloquently and forcibly written, and will be found pleasant, and to some instructive, reading.

A Toxicological Chart, &c. By E. B. Stowe. London: Churchill and Sons. 1864.

Aids to memory such as this chart are sometimes condemned as encouragements to ignorance or forgetfulness. The pictures drawn in our minds, however, as Locke (we think it is) says, are laid in fading colours, and if not sometimes refreshed, vanish and disappear. A medical man who very seldom gets a poison case to treat might well be excused for forgetting at the instant the exact antidote to apply; and the best stored memories sometimes fail to reproduce a fact in a moment of excitement. We may give an illustration. We were once present when a medical student unintentionally swallowed a large dose of tartar emetic, and suffered all the symptoms of poisoning by that agent. Probably all those who were present (some four or five), if they had been asked quietly the chemical antidote for tartar emetic, would have answered correctly enough tannin. But under the circumstances, no single one thought of the remedy, and the unhappy patient was left to Providence and the stomach-pump—the latter apparently an unnecessary agent. It is in cases of this kind that a chart such as we notice proves useful, and when hanging up in a surgery it saves the trouble of looking for a book, referring to the index, and turning up the page containing the information wanted.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

156. James Wilson, Royal Exchange Buildings, London, "Improvements in hydraulic valves for working gas purifiers."—Petition recorded January 21, 1864.

358. George Davies, Serle Street, Lincoln's Inn, London, "Improvements in the manufacture of sulphuric acid."—A communication from John Smith and John Richard Savage, Philadelphia, Pennsylvania, U.S.

360. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in the manufacture of super-phosphates to be employed in the making of bread, and in other purposes in the arts."—A communication from Anthony Pollak, Washington, U.S.

363. Peter Armand Lecomte de Fontainemoreau, South Street, Finsbury, London, "Improvements in photographic apparatus."—A communication from Messrs. Alphonse Liébert and Jean Lafon-Saint-Cyr, Paris.

364. James Slack, Manchester, "Improvements in filters and filtering media for filtering marine and other water or condensed steam, and the application of the said filters and filtering media to marine engines and other condensers."—Petitions recorded February 11, 1864.

372. William Drake, Sheffield, Yorkshire, "Improvements in the manufacture of iron."

414. Henry Young Darracott Scott, Chatham, Kent, "Improvements in the manufacture of cement."—Petitions recorded February 17, 1864.

Notices to Proceed.

2641. Marius Vian, Marseilles, France, "Certain compositions for preserving iron ships and other submerged iron-work from corrosion and from fouling."

2670. William Nall, Wharf Street, Leicester, "Improvements in ornamenting glass and sheet gelatine."

2680. Frederic Newton Gisborne, Adelaide Place, London Bridge, London, "An improved composition for coating ships' bottoms."

2720. Julian John Revy, Grosvenor Street, Eaton Square, "Improvements in the manufacture of explosive compounds."—Petitions recorded November 3, 1863.

2725. John Thomas, Battersea, Surrey, "Improvements in preparing ores and earths containing copper for smelting."

2753. John Muckart, Letham Mill, near Arbroath, Forfarshire, N.B., "Improvements in preserving certain vegetable substances."

CORRESPONDENCE.

Continental Science.

To the Editor of the Chemical News.

Paris, March 29.

Sir,—The number of dictionaries and encyclopædias of science is daily increasing, men of ability devote themselves to their production, and endeavours are constantly made to popularise science—that is, to express their discoveries in popular phraseology, and to avoid the technical expressions employed in works on scientific subjects. The attainment of this object is, however, materially aided by the circumstance that the phraseology of science is gradually becoming better known to the world at large; so that there is no longer the same difficulty experienced in expressing scientific discoveries in a generally understandeble manner. It may be interesting to your English readers to be informed that a Dictionary of Science has been recently published by MM. Privat-Deschnel et Focillon, and edited by MM. Tandon, Masson, et Garnier, in which these ends are endeavoured to be attained. The publishers have aimed at producing a book, not only useful, but ornamental, and have intercalated in the text a number of vignettes from the hands of the most eminent engravers. It is expected that the dictionary will meet with great success.

A process for restoring writing on parchments, &c., which has faded through age, is a *desideratum*, although this problem would present no great difficulty to a chemist. M. Moride recommends the following mode of proceeding:—Soak the parchment in distilled water, then in a solution of oxalic acid, afterwards in gallic acid, and again in water. It is necessary to perform these operations quickly to avoid colouration of the surface of the paper. The dangers attending the employment of lucifer-matches have been considered by M. Dumas, in consequence of a recommendation by Dr. Lunel that amorphous phosphorus should be employed, instead of ordinary phosphorus, in the process of manufacture. It is stated that of forty-three fires occasioned by matches, twenty-one occurred through infants playing with stray ones left lying about. From this he concludes that matches fired by such slight friction as that occasioned by the foot, &c., are dangerous. He goes on to say that it might be desirable to prohibit, or at least restrain, the sale of these matches, such restriction being of especial importance to infants, who are very often the first victims of the accidents resulting from this cause.

The great convenience of matches renders it almost impossible either to prevent or restrict their use; the present form of match may, however, be replaced by a safer kind. Safety may be considered almost completely attained in those matches in which the oxidising material is placed on the end of the match, and the combustible on the box, for under these circumstances there is very little danger of fire, and this kind of match will probably in time completely replace that in use at present.

Paris, like London, is blessed with many doctors, who fill the journals and cover the walls with their advertisements; such being the case, it appeared desirable to the Commission of the General Association of Doctors of the Seine, that there should exist exact lists, comprising the names of all the doctors or officers of health authorised to exercise the art of medicine, and that these should be easily accessible. In answer to questions on this subject addressed to him by the President of the Commission, the Minister of Public Instruction states that such lists are already in existence, and carefully preserved in a special répertoire, where they can be consulted. By means of these it may be easily ascertained whether a medical man is a recognised practitioner, and the public can effectually protect themselves from quacks.

On the 20th and 21st of February a singular fall of dust is reported to have taken place at Rome, preceded by a violent south wind, the wind being followed by a great rain, and the rain being accompanied by the dust. It appeared to consist of fragments of shells mixed with silicious grains; it effervesced with acids, but a great part rested insoluble. The dust is supposed to have come from the desert of Sahara, being carried across the sea by the wind. The distance to which it was carried need not create astonishment if it is remembered that Rome is not situated much farther from the desert than are the Cape de Verd Islands, and dust has been carried out to these in such quantity as to render the air dark. In fact, it is asserted by M. Maumené that dust is sometimes carried by the wind even across the Atlantic. We are all aware of the effects of the dust brought to our own island by an east wind, such winds causing a peculiar irritation in the skin, from the presence of minute gritty particles floating in the air.

An interesting case of the healing of a large wound is mentioned in one of the French journals, the wound being caused by a bull, the sufferer being a young shepherd, whose abdomen was torn right across its largest diameter. The viscera was inundated with blood, which enclosed in its clots all sorts of foreign bodies. In spite of all these exciting causes, no inflammation took place, from the first commencement to the total healing of the wound. Two years after the accident the wound was examined —the cicatrice was solid. Seven years afterwards the patient, who was 20 years old, enjoyed perfect health, and had a strong constitution. At the left extremity of the scar there was a tumour of about the size of an egg, reducible by pressure. This, however, gave no pain, and the wound was considered perfectly healed.

The Spectrum of Carbon and the Theory of the Candle Flame.

To the Editor of the Chemical News.

Sir,—In your notice last week of M. Morren's confirmation of my experiments on the light emitted by flames containing carbon, you say you do not understand what experimentalists mean by "the vapour of carbon" as existing in a flame. M. Morran obviously means carbon in the free, uncombined state; for he says "carbon can only exist *alone*, and give its luminous reactions when it has near it the high temperature produced by the combustion of hydrogen." On referring to my original paper "*On the Spectrum of Carbon*," *Phil. Trans. Roy. Soc.*, 1862, p. 221, you will find that I simply mean carbon in a non-solid state.

Whether, in the flames of alcohol, hydrocarbons mixed with air, cyanogen, carbonic oxide and bisulphide of carbon, the vapour of carbon exist in the free or in the combined condition, is a matter on which I have never expressed an opinion. If combined it is curious that the hydrogen, oxygen, nitrogen, or sulphur with which the carbon may be associated exerts no influence on its spectrum; such a state of things would go far to show that the spectrum of a compound may simply be the sum of the spectra of its constituents. If, on the other hand, the carbon at the moment of giving light be uncombined, it is necessary to assume that in Berthelot's experiment of forming acetylene by passing an electric current from carbon poles through an atmosphere of hydrogen a portion of the acetylene is decomposed by the same force that caused its formation; for M. Morren finds that ignited acetylene also gives the spectrum of carbon.

The modified theory of the candle flame is M. Morren's, not mine. I am, &c. John Attfield.

17, Bloomsbury Square, March 21.

The Word "Radical."

To the Editor of the Chemical News.

Sir,—Since writing to you last week upon the subject of the orthography of the word "radical," I have inquired further into the derivation of this term, and referred to numerous scientific publications for the purpose of ascertaining the authority upon which the word "radicle" has been of late frequently substituted. As the result of such critical examination, I am prepared with evidence of the most conclusive character to show that the use of the original word "radical" was practically universal during the first half of the present century, and that it is still employed by some of our most eminent authors.

"Brande's Dictionary of Science, Literature, and Art," (third edition, 1853) gives the following account of the two words in question:—

"Radical (Latin, Radix—*a root*).—In Chemistry, is a term occasionally used as synonymous with *base*. The term *compound radical* is applied to certain organic combinations; in this case compounds of carbon, hydrogen, or nitrogen constitute the principal radicals.

"Radicle.—In Botany, that portion of an embryo which eventually becomes the descending axis or root."

Noah Webster, in his "Dictionary of the English Language" (eighth edition, 1860), agrees with Brande as to the meaning of the words "radical" and "compound radical," and quotes from Ure and Silliman in support of this view.

F. Aecum, in his "System of Chemistry,"—London, 1803,—(vol. I., p. 15) describes the "muriatic radical" and the "fluoric radical" as bodies which had not been isolated, but of which the existence and simple nature might be inferred by analogy.

Again, we turn to the French "Abrégé de Chimie, par J. Pelouse et E. Fremy." Paris. 1853. The authors, in describing the constitution and properties of cyanogen, make use of the following words:—"Le cyanogène a fourni en effet le premier exemple d'un *radical composé*, c'est-à-dire d'un corps composé se comportant dans la plupart des réactions comme un corps simple."

M. Jourdan, in his "Traité Pratique d'Analyse Chimique" (the French translation of Rose's work, 1843), describes hydrocyanic acid as "un hydracide à *radical composé*."

In proceeding now to refer to specific opinions gathered from the published works of several eminent chemists, it is necessary to point out the circumstance that, whilst Professors Hofmann and Brodie adhere to the original word "radical," the majority of authors seemed to have changed their opinions, and adopted the other word—"radicle." There is every reason to believe that the interpretation now attached to these words is identical, notwithstanding the difference in the mode of spelling, but I will not venture to assert positively that this is the case until I have had an opportunity of making further inquiries into the matter.

I have referred to forty-nine volumes and papers by our most distinguished chemists, and I find that in thirty-three instances the word *radical* is employed, while in sixteen *radicle* is used.

It thus appears that there is a considerable diversity of opinion in regard to the correct orthography of this word "radical." I leave the reader to draw his own conclusion. I am, &c. J. S.

March 21.

[There can hardly be two opinions, we imagine, about the use of these two essentially different words. *Radicle* (Radicula) is strictly a young or little root. *Radical* (Radicalis) in its primary signification means rooted, but it is also used in the sense of primitive, inbred, and in its English substantive form correctly enough indicates a base or something from which other things take root or arise. Some chemists may conceive that there may be radicles of radicals, but in the ordinary sense of the term among chemists there can be no doubt that *radical* is the proper orthography.—Ed. *C. N.*]

Extraction of Iron from Furnace Cinders.

To the Editor of the Chemical News.

Sir,—In your paper of November 14, page 241, is found some severe strictures of Professor F. Crace Calvert, of the Royal Institution of Manchester, on my communication relating to a novel process of utilising the cinder of puddling and reheating furnaces, published in your valuable Journal, October 31, 1863.

Strictures from so able a pen as that of Professor Calvert should call forth some reply, unless the subject animadverted upon is indefenceless. It is due to the development of science, and somewhat to myself, as the discoverer of a process to render available millions of tons of valuable material that has, heretofore, been looked upon as of little or no value, to reply to those strictures. And by your leave, I beg to take up the charge of the Professor, and show wherein he is correct, and wherein he labours, or has laboured, under a misconception or non-conception of my mode of treatment.

The Professor says that in August, 1854, he took out a patent for employing cinders of puddling and refining furnaces, so as to enable iron masters to use them in larger proportions in their blast furnaces, which patent, he says, is "identical" with that of M. Fleury; and after stating the specification in that patent, adds: "I soon found that this process was not practicable, owing to the enormous expense of grinding the cinders, and afterwards mixing them with slacked lime, and making the whole into bricks; and, lastly, because the constant vibration which exists in blast furnaces, owing to the working of the engine, caused the bricks to fall into powder and to interfere with the draught, and, consequently, to impede the working of the furnace."

It is not at all to be wondered at that the cinders mixed with slacked lime crumbled in the blast furnace, and interfered with the draught, but it is somewhat to be wondered at that a professor of metallurgic chemistry should mistake the process of M. Fleury for a process so defined, as well in the specification of the patent as in its practical workings, and so mistake it as to declare it "identical." The truth is, that not a particle of slacked lime is used in the process of M. Fleury. M. Fleury has long been conscious that slacked lime has no property of cohesiveness with the mixed compound of the cinder, notwithstanding it may have, as a flux, with a molten mass.

Mr. Calvert might well apply, in 1855, for a new patent, which he says he did, per consequence of the failure of his 1854 patent to answer the expectation of the inventor; and, although his new patent is a nearer approach to the patent of M. Fleury, yet it is vastly different in several very essential and important particulars. But, before stating the particulars, let me observe that if the process with slacked lime was found not to answer, and the process with 20 per cent. of quick lime, 30 per cent. of slacked lime, or 50 per cent. of carbonate of lime, was "carried out with perfect success on the continent and in South Wales," the difference must be attributable, in the first division of that process, to the action of quicklime, and in the latter division of that process to the action of carbonate of lime on the components of the slag. The chemical action of 20 per cent. of quicklime and 30 per cent. of slacked lime on the silica contained in the slag, when in a state of fusion, is certainly very different to the chemical action of 50 per cent. of slacked lime mixed with ground slag, and water sufficient to make them into a paste. And the chemical action of 50 per cent. of the carbonate of lime mixed with slag, in a state of fusion, is also very different to 50 per cent. of slacked lime with ground slag, and water sufficient to make them into a paste. And yet another and altogether different chemical action on the silica contained in the slag takes place when the slag is ground and mixed with caustic lime, together with sufficient water (in which has been dissolved some chlorine salt) to form the slag and lime into a paste. The hydration or slacking of the lime in close contact with the silica contained in the cinder gives rise to two distinct results. First, the heat produced during hydration and the alkaline reaction of the lime induces a partial gelatinisation of the silica, and forms a strong cementing substance—a silicate of lime. Secondly, by the abstraction of the silica from the cinder an action on the protoxide and the peroxide contained in the mass is induced, which brings the former to the state of the latter, and the chlorine salt being intimately mixed with the whole mass, takes hold of the sulphur which clings to the iron, and prepares it for elimination in the furnace. Brick or blocks made of this compound will not "fall into powder and interfere with the draught" of the blast-engine, nor will they "impede the working of the furnace." This latter is my process, and you will perceive, Mr. Editor, that it is not "identical" with any of the processes patented by Mr. Calvert. The percentage of lime used by me varies to suit the quantity of silica supposed to be present in the cinder.

One word more as to chloride of sodium, and I will bring this already too lengthy communication to a close. This material has been used for the purification of metals from antiquity, or works of scientific data have led me greatly astray. I am, &c.

A. E. Flauay,

Office: Building of the Franklin Institute.

Philadelphia.

MISCELLANEOUS.

Royal Institution.—Monday, April 4, at two o'clock, General Monthly Meeting. Tuesday, April 5, at three o'clock, Professor Helmholtz, F.R.S., "On the Natural Law of Conservation of Energy." Thursday, April 7, at three o'clock, Professor Helmholtz, F.R.S., "On the Natural Law of Conservation of Energy." Friday, April 8, at eight o'clock, Dr. John Percy, F.R.S., "On Iron." Saturday, April 9, at three o'clock, Professor Frankland "On the Metallic Elements."

Iridium.—Many inquiries having lately been made respecting this new metal, we may remind our readers that a very full account by the discoverers—MM. Reich and Reichter—appeared in our 8th volume, p. 280. No further description has since appeared.

Young v. Fernie.—This suit, which has continued for eighteen days, is adjourned until after the Easter holidays. It is anticipated that it will, when resumed, be concluded within a week.

Evening Instruction in Chemistry.—We have been so often applied to by correspondents wanting practical instruction in chemistry in the evening, that we may call special attention to the Birkbeck course, which commences at University College on May 3. The hours are from 7 to 9 p.m., twice a week. The class is conducted by Professor Williamson and Dr. Russell.

The Sale of Petroleum.—On Tuesday last a meeting of gentlemen interested in the petroleum trade was held at the Baltic Sale-room, for the purpose of considering certain resolutions which had been brought under the consideration of a committee appointed to report on the best rules and regulations for the conduct of this branch of trade. The following resolutions among others were agreed to:—"That the lowest point of ignition of refined oil be 100° Fahr." "That the gravity of good merchantable refined Pennsylvanian petroleum is not to exceed 812°, at a temperature of 60° Fahr.; and the gravity of good merchantable crude Pennsylvanian not to exceed 820°.

Renard v. Levinstein.—Our advertising columns will have informed our readers that another important suit relating to the aniline dyes is in progress. These beautiful colours seem to be almost as profitable to the gentlemen of the long robe as to the chemists who discover them, and to be as productive of litigation as they have been of scientific investigation. The patent in dispute this time is that of Girard and De Laire (No. 97, January 12, 1861) some notice of which will be found in Dr. Hofmann's paper, page 49, vol. viii., of the Chemical News, and also at page 141 of our present volume. It is for the production of a blue dye by heating red aniline dye with an excess of aniline. The plaintiffs in this case obtained an injunction from the Vice-Chancellor, an appeal for the dissolution of which was made by the defendant to the Lords Justices. The presumption of the plaintiffs appears to be that no aniline blue can be made without infringing Girard's patent; the defendants, however, allege that their blue is a different colour from that obtained by Girard's process, inasmuch as it is free from violet tinge, and that their process itself is different, as well in the nature of some of the materials used as the proportions and the temperature employed; in fact, that both the process and product are different from Girard's. The Lords Justices have dissolved the injunction on the grounds that no infringement had been proved, and that the validity of Girard's patent was open to dispute. Further proceedings are pending to establish these points. As usual, our most eminent chemical authorities are ranged on opposite sides. Drs. Hofmann and Odling, and Mr. Warrington supporting the plaintiff's case, and Professors Miller and Williamson and eminent foreign chemists appearing for the defendants. We shall await the coming trial with some interest. The case being *sub judice*, we can say nothing further on the subject; but it is clear that when such eminent authorities are to be found on each side, the chemical questions involved in the matter must be fairly open to dispute. The recurrence of such trials makes us regret the want of a proper tribunal for hearing these cases; but this case, like that of Young *v.* Fernie, will probably be tried before a Vice-Chancellor without a jury; so some decision will certainly be arrived at on this trial.

Sir John Herschel's New Theory concerning the Solar Spots.—To account for the periodicity of the solar spots, Sir John Herschel, in an article in the *Quarterly Journal of Science*, throws out a suggestion whether (granting the possibility that they may originate, directly or indirectly, in disturbances of an impulsive, vorticose, or fluctuating nature, propagated into the photosphere from the higher and more attenuated region of the sun's atmosphere) the *vis matrix*, or original exciting cause, may not be found in the circulation of an elliptic ring of planetary matter, in a state of division sufficiently minute to elude telescope vision, having a major axis such as would correspond to an average period of 11⅛ years, and an eccentricity such as to bring its perihelion within the region in question; the matter of the ring being unequally distributed over its circuit, with a minimum and a maximum following in by an interval somewhat less than its semicircumference. By assuming certain conditions as to the constitution of such a ring, and the extent of deviation from exact equality in the periodic times of its component elements, he finds that not only the shorter period of 11⅛ years in the recurrence of the spots first determined, but also the longer one of 56 years subsequently insisted upon by Dr. Wolf, as well as the alternate increase and diminution of the maxima of maculiferous energy, are susceptible of explanation, as well as some other periodically-recurring peculiarities in their phenomena noticed by Mr. Carrington.

Relations Between the Chemical Equivalents and the Densities of Bodies.—M. Fleck, Professor of Chemistry at the Dresden Polytechnic School, finds that simple bodies form several groups, in which the relation of the equivalent to the square of the density is invariable, and that these constant volumes are generally entire multiples of the value borne to potassium. Without attaching too much importance to this rather problematical law, we believe it is of sufficient interest to attract attention. M. Fleck says that the constant quantity of potassium is the square of 7·2358,—that is to say, 52·3575—a number obtained by dividing the equivalent, 39·2, by the square of the specific weight, 0·865. The *atomic factor*—that is to say, the entire number by which this constant quantity must be multiplied for each of the simple bodies, is as follows:—

1	for potassium
2	,, sodium
3	,, lithium and barium
6	,, calcium & phosphorus
8	,, strontium
10	,, iodine
14	,, sulphur & magnesium
16	,, silicium
20	,, antimony
22	,, arsenic
24	,, bismuth
28	,, aluminium
30	,, selenium
32	,, tellurium
36	,, borax (and thallium?)
48	,, tin
54	,, silver
65	for lead
68	,, cadmium
84	,, zinc and molybdene
100	,, gold chromium and manganese
104	,, carbon (diamond)
108	,, mercury (solid)
112	,, iron
128	,, cobalt
130	,, ruthenium
132	,, copper
140	,, nickel and palladium
168	,, tungsten
232	,, platinum
235	,, iridium
240	,, osmium.

If the atomic factor for cæsium and rubidium were equal to units, their densities would respectively be 1·536 and 1·276. M. Fleck has tried to determine the atomic factors of several other simple combinations, but we will not follow him on such speculative ground.—*R. Radau*, *Moniteur Scientifique*, v. xxix., 63.

The British Association will hold its next meeting at Bath during the week commencing Wednesday, Sept. 14, under the presidency of Sir Charles Lyell, F.R.S.

ANSWERS TO CORRESPONDENTS.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 2d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

E. B.—We doubt whether you do come under the Act, but you had better ask your solicitor. We cannot say where you must register if you should be compelled to. Notice will no doubt be given when the districts are settled.

W. B., *E. C.*, *I. F.* received.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Thallium in Lepidolite and Mica.[*]

Professor Schrötter announces to the Vienna Academy that he has discovered thallium in lepidolite and mica. To prove the presence of this metal, he says it is not necessary to use a large quantity of the material. The author seems to take the mixture of the double chlorides of platinum with the potassium, cæsium, rubidium, and thallium, obtained from the above sources, removes the potassium, and then reduces the other chlorides in a stream of hydrogen at a low temperature. He then treats the well-washed platinum sponge with sulphuric acid, and by the repeated washing out of this obtains a solution which shows the characteristic reaction of thallium. It may be open to doubt whether the thallium in such an experiment does not come from the sulphuric acid, in which the metal may be commonly found.

On the Preparation of Toluidine, by Dr. Hugo Muller.[†]

Dr. Hofmann's researches on the aniline colours having shown the importance of toluidine in their formation, a communication on the preparation of this body may not be without interest. Toluidine as it is ordinarily obtained from the toluol of coal tar naphtha is fluid or semi-fluid; or under most favourable circumstances a crystalline mass which still retains a considerable quantity of a liquid base (aniline) from which the pure crystallised toluidine is only separated by a tedious process. This contamination with aniline arises from the fact that we are usually compelled to work with toluol, the boiling-point of which is only occasionally near that of pure toluol.

The boiling point of pure toluol as determined by Mr. Church is 103·7. The author states that he has often prepared toluol, and according to his experiments the boiling-point lies between 111° and 113°, which agrees more nearly with the determinations of Canizzaro, Noad, and others.

Toluol boiling between 111° and 113° yields toluidine as a solid, beautifully crystalline mass; but for the preparation of toluidine on a large scale it is not necessary to use toluol of a constant boiling-point. It suffices to employ a toluol the greater part of which distils between 108° and 114°. In the conversion of toluol into nitrotoluol it is necessary to use some caution, since toluol has a strong disposition to form binitrotoluol. It is best to employ sulpho-nitric acid, and, as in the case of nitrobenzol, to add the acid slowly.

The reduction of nitrotoluol by means of iron and acetic acid takes place as easily as the reduction of nitrobenzol, and the toluidine is obtained as a crystalline mass, which can be purified in the following way:—For this purpose of purification the author employs the more volatile hydrocarbon (preferably the heptylhydride C_7H_{16}) boiling between 80° and 100°, obtained from Rangoon tar or American petroleum. The latter product, which is easily procured, answers well. A simple washing with this liquid suffices to remove all the aniline from the toluidine. By solution and re-crystallisation from this liquid, toluidine is obtained in perfectly colourless crystals, which do not become brown by keeping. In this way a large quantity of chemically-pure toluidine can be easily obtained.

TECHNICAL CHEMISTRY.

On the Preparation of Iodide of Ammonium,[‡]
by Dr. Jacobsen.

The author dissolves equivalent weights of pure iodide of potassium and pure sulphate of ammonia in the smallest possible quantity of boiling distilled water. One part of sulphate of ammonia will require about one and one-third of its weight, and iodide of potassium about half its weight of boiling water for solution. The two solutions are then mixed and well stirred. After the mixture has cooled, water containing 15 per cent. of alcohol is added, and the whole is allowed to stand twelve hours. In very cold weather less alcohol will suffice to separate the sulphate of potash formed. According to Schiff,[§] 100 parts of water and 10 parts of alcohol at 15° C. only dissolve 3·9 parts of sulphate of potash.

The iodide of ammonium, in consequence of its greater solubility, remains in the solution, which is now drained from the precipitated sulphate of potash, filtered, and evaporated until a pellicle forms. As the solution is very concentrated, the evaporation is quickly effected.

After the crystals of iodide of ammonium are formed, they are drained from the mother liquor, which, together with the residue of sulphate of potash, is again treated with dilute alcohol, and the liquor evaporated for a further yield of sufficiently pure iodide. Care must be taken to exclude all acid vapours from the chamber in which the evaporation is carried on; and it is well to add to the solution from time to time a few drops of ammoniated alcohol.

English Atropin!—We find the following in the *Chemisches Centralblatt* for March 19:—"English atropia is preferred to the German because its action appears to be safer. Hager believes the preference to be owing to the fact that in England *daturin* is sold instead of atropia, the former, according to Jobert, acting quite as powerfully as atropia, and causing neither pain nor confusion of vision. The dilatation of pupil caused by daturin is also said to last longest." Is either atropia or daturin made in England?

Solar Radiation.—Father A. Secchi has made a series of experiments on the intensity of the solar radiation in different seasons. His apparatus consisted of two cylinders, placed one within the other, the space between the two being filled with water at a certain temperature; the aperture of the inner cylinder is closed at one end by a plate of glass, the other is partially closed by a diaphragm with an aperture; a thermometer with a blackened bulb is placed in the axis of the inner cylinder. On presenting this instrument to the sun, it was found that the same difference of temperature between the inner thermometer and that in the water was sustained, whatever was the temperature of the water, but that the difference of temperature between the two produced by the sun at midday was almost the same in summer as in winter, although the rays had to travel about twice the thickness of the atmosphere, the cause of this remarkable phenomenon being the vapour of water in the air, which was much greater in summer than in winter, this fact fully bearing out the observations of Professor Tyndall as to the power of the vapour of water to intercept the sun's rays.

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[*] *Journ. für prakt. Chem.*, No. 1, 1864, p. 45.

[†] Abridged from *Zeitschrift fur Chem. und Pharm.*, &c., 1864, p. 161.

[‡] *Neues Jahrbuch. für Pharmacie*, bd. cxx. vii., s. 256.

[§] *Ann. der Chem. und Pharm.*, bd. cxviii., s. 365.

Vol. IX. No. 227.—April 9, 1864.

PHYSICAL SCIENCE.

Mr. Tomlinson's Experiments on the Electrical Fly.

In the Chemical News, vol. viii., p. 124 and p. 169, the electrical fly is referred to as a retroactive machine. "The force with which electricity leaves the points is accompanied by a proportionate recoil, which causes the fly to spin rapidly on its centre." This recoil theory has been held by electricians of repute from the time of Hamilton, who invented the fly in 1760, to our own day, Pouillet and Snow Harris still advocating it. Other writers, however, have adopted different views. Thus, Kinnersly, in 1762, finding the fly to revolve with the points backwards, whether electrified + or −, supposed the fly when electrified + to be attracted by the particles of air electrified −, which would be in greater force behind the shoulders of the fly than at the points, so that the latter would be pulled backwards. Thirdly, Beccarie supposed the fly to rotate by an expansive force due to the escape of electricity from the points whereby it drove the air forwards and the points backwards. Fourthly, Biot, Roget, Becquerel, and De la Rive adopting Poisson's view, that electricity is held to the surface of insulated conductors by atmospheric pressure, if a conductor be furnished with a point, the pressure will be at a minimum at that point, the electricity will escape from it, and if the point be free to move there will be a recoil. Fifthly, Cavallo, Riess, Ganot, and one or two others suppose that the electricity escaping easily from the points electrifies the air in the same manner as they themselves are electrified, and so there is repulsion between the air-particles and the points.

Mr. Tomlinson has recently investigated these various theories of the electrical fly, and the results of his labour are given in a paper in the *Philosophical Magazine* for March. We propose to give a short account of this paper.

The subject is considered under seven heads. 1. Historical. 2. The fly in air. 3. The fly enclosed in glass vessels, etc. 4. The fly in rarefied air. 5. The fly in liquid dielectrics. 6. The fly with the points modified. 7. Conclusions.

As a prelude to the investigation, it was thought necessary to define clearly the action of a point on an insulated charged conductor. Such a conductor throws surrounding objects into an opposite electrical state, and the intervening air is polarised. By means of the air discharging itself upon the prime conductor the charge is gradually dissipated. If a point project from the conductor, the lines of force accumulate more easily upon it than upon any other part, and discharge takes place with sufficient rapidity to produce the electrical aura or gale of wind; that is, supposing the conductor is kept charged by working the electrical machine. Under such circumstances, each polarised particle discharges itself by its opposite side upon the point, and becomes electrified as a whole with electricity of the same name as the point. It is then repelled by, and repels the point, so that the latter, if free to move, will thus be set in motion. This is Dr. Faraday's convective discharge theory applied to the explanation of the electrical fly in the air, and it is quite satisfactory, as may be abundantly proved by experiment. The difference between Mr. Tomlinson's theory and that of Cavallo, Riess, and Ganot is this:—They suppose the electricity to pass off readily from the point, and so electrify the air; whereas it is the air that fetches the electricity from the point, becomes electrified in the same manner, and thus produces repulsion.

If the fly on its supporting point be held at some distance from the prime conductor of a machine in action, it will rotate briskly. If insulated it will not rotate. In the one case the polarised air can discharge upon its points; in the other the fly is rendered polar like the air, and is seeking to discharge upon the prime conductor. If the uninsulated fly be enclosed in a bell glass it cannot rotate, because the circulation of the polarised particles is arrested. If a chain from the prime conductor be connected with the metal support to the fly (insulated) there will still be no motion, for a similar reason; but if a point be held near the outside of the bell-glass, the fly will rotate briskly, because in such case the jar can become charged. The electricity of the fly is conveyed by the air to the inner side of the glass, and the point dissipates the electricity of the same name from a portion of the outside of the glass. In like manner, when the inside of a bell-glass is electrified (by allowing a chain from its prime conductor to rub against its inner surface) and so placed over the fly, its metal support standing on a copper disk on a glass-legged stool, there is no motion until the copper disk and a portion of the bell-glass be touched by the hand; the fly then starts off with great speed, but comes to rest as soon as equilibrium is attained. It may be set going again by again discharging a portion of the glass, and so on many times.

When the air in the bell-glass is rarefied to about 1-inch pressure the electrified fly does not rotate when a point is held outside, because in such case the particles of air are not sufficiently numerous to produce mechanical force.

When the fly is held near the knob of a charged Leyden jar, it is first attracted and then repelled, the air between the knob and the points discharging upon the latter, and so producing motion as before explained.

When the fly is placed on a supporting point in liquid dielectrics, such as turpentine, paraffine oil, benzole, &c., which are connected at opposite points with the prime conductor and the earth, a powerful current is produced, whereby the liquid is thrown into a kind of whirlpool, in which the fly is swept round, not as in air with the points backwards, but with the points backwards or forwards, according to the direction of the current, and this depends on the position of the conducting wires. By adjusting these, the current, and with it the fly, can be made to rotate from left to right or from right to left at pleasure. The liquid should be placed in a shallow glass dish six inches or more in diameter.

A good illustration of the mode in which the particles circulate and discharge upon the electrified wires was obtained by removing the fly and the supporting point from the liquid, and stirring up in it a number of particles of gold and silver leaf. On placing a wire from the prime conductor in the liquid and holding a point connected with the earth over the liquid, the metallic particles started asunder, became polarised, and began to circulate in the most orderly manner between the two wires. The particles arranged themselves in parallel lines, moved towards the + wire, discharged upon it, became electrified +, were repelled, and passed in an opposite direction outside the parallel lines to the − wire, discharged again, and joined the parallel forces that were moving towards the + wire. This experiment renders visible the action that we must suppose to take place between the electrified particles of air and a point attached to a charged conductor. It also renders the behaviour of the fly in air quite clear.

When the points of the fly were struck into little pellets of bees'-wax, the fly in air did not rotate with the points backwards, as usual, but with the points forwards. Now, under ordinary circumstances, the convective discharge on each point is marked by a brush, showing that the polarised particles are discharging on the point, and becoming similarly electrified produce repulsion. If the point is concealed, discharge cannot take place upon it, but it does so on the nearest approach to a point that the apparatus affords, and that is the bend or shoulder of the fly. A brush, visible in the dark, may be seen from the shoulder, and this, as before, producing motion by repulsion, sends the fly round with the bees'-wax knobs forwards. It is, however, very curious that if a lighted candle or the flame of a spirit-lamp be brought near the fly while thus rotating with the wax knobs forwards the motion will slacken, cease, and then set in with the knobs backwards, just as if the points were quite free. In such cases the flame, and the hot air about it, rob the fly of most of its electricity, and act by repulsion upon the most prominent parts of the fly, namely, the wax knobs. In such case the brushes disappear from the shoulders of the fly.

The conducting action of flame was shown by placing a metal pointed stand connected by a chain with the prime conductor on a porcelain dish containing spirits of wine. On working the machine the fly on the point spun rapidly, but when the spirits were kindled the fly stopped, and did not begin to spin again until the flame had died out.

The conclusions to which the author is brought by his various experiments is (1) that the fly in air rotates by repulsion as before explained, (2) that it does not rotate in vacuo or in highly rarefied air where the particles of the dielectric are not in sufficient force to produce mechanical action by repulsion, (3) that the fly does not rotate under cover unless means be taken to allow the dielectric to circulate, (4) that in liquid dielectrics the fly has no distinctive action, but is swept round by the current excited in the liquid, either from left to right or from right to left, according to the position of the conducting wires; (5) that the fly in air may be made to rotate with the points forwards or backwards, if means be taken to transfer the brush which marks the convective discharge from the point to the shoulders, or *vice versâ*, (6) that the action of flame is to draw off electricity of the same name as that of the fly, and so produce repulsion.

The general conclusion is, that "there is no one expression that fairly represents the electric fly. It modifies its behaviour according to circumstances; and like a good subject, has no law of its own, but conforms to the laws of the community of which it is a member."

Replacement of Species.—Dr. Hooker has made some interesting remarks "On the Replacement of Species in the Colonies and Elsewhere." As examples, he brings forward the Cardoon in the Argentine provinces, the Anacharis in the rivers of England, and some very remarkable cases of importation of weeds to Australia and New Zealand. In New Zealand the cow grass is rapidly spreading all along the sides of the main lines of roads; the dock is to be found in every river-bed, the sow-thistle is spread all over the country, and water-cresses threaten to choke up the rivers. A saying of the native Maories is that "as the white man's rat has driven away the native, so will the European fly do; and as the clover kills the fern, so will the Maories disappear before the white man." Many other instances of replacement are given.

PHOTOGRAPHY.

The Magnesian Light.

PHOTOGRAPHERS are indebted to the perseverance of M. Sonstadt for the removal of a great obstacle. Every one knows the difficulty which has hitherto been experienced in getting a powerfully actinic artificial light. Such a light is, however, furnished by the combustion of the metal magnesium, and, thanks to M. Sonstadt, this metal is now procurable at a price which makes it available for practical purposes.

Magnesium is an easily-inflammable metal. A wire of considerable thickness can be ignited in the flame of a candle, and the light evolved by the combustion is of great intensity. It has been ascertained that a wire of 0·297 millimetre diameter will give as much light as twenty-four stearine candles of five to the pound. The powerfully actinic character of the light has been recently demonstrated by Mr. Brothers, of Manchester, and Mr. Sydney Smith, both of whom have produced good pictures by its use.

The metal is neither ductile nor very malleable. It cannot be drawn, but by employing a method devised by Dr. Matthiessen it can be forced in a softened state through a small opening in an iron cylinder, and thus strands of wire of considerable length can be formed. The wire has been found to burn more steadily when three or four strands are twisted into a rope; and a simple clockwork arrangement will deliver such a rope to a spirit or oil lamp, in the flame of which it may be burned.

We look for important results from the use of this light. The opportunities for its use are numerous; and we may expect our collections to be soon enriched with pictures of objects hitherto shut out from photographers.

Some are talking wildly of "night pictures," as though they expected, by means of magnesium, to obtain a picture of the gloomy effects of midnight on a scene. The principal use of the light will, of course, be for dark interiors; and we hope soon to see the magnificent grottoes of Adelsberg and Antiparos—which the pencil is as powerless to draw as the unaided camera to depict—revealed as brightly as the caverns in the glaciers, so well known to photographers. Another Frith may also show us the wonderful passages in the interior of the Pyramids more clearly than they have ever been seen by the traveller with the help of the two or three candles which light his way through the dark labyrinth, and enable us at our own firesides to gaze with awe on the vast range of subterranean tombs at Serapeum. All these and many more objects are now open to an enterprising man, who will no doubt soon be found to avail himself of them.

New Application of Photography.—A somewhat new application of photography, to which the name orography has been given, has lately been made. M. A. Cavilte has applied it to the examination of the geology of the Saint Gothard and the Canton des Grisons; he has prepared four panoramas, and a number of views of details. Geology will be greatly assisted by this application of the art of photography.

Reduction of Photographic Ashes.—Davanne recommends two and a-half parts of white sand and five parts of dried carbonate of soda to be mixed with ten parts of ashes. The addition of the sand makes a more liquid flux, and the silver runs together more easily.—*N. Jahrb. fur Pharm. B.*, xx., s. 150.

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture VIII.—*Saturday, January 16, 1864.*

We shall proceed this morning to the subject of magnetic oxide of iron, which we mentioned on the last occasion. Magnetic oxide of iron consists of three equivalents of iron and four of oxygen—Fe_3O_4. It occurs beautifully crystallised in nature, and may also be prepared artificially, well crystallised. In this large vessel before you, we have made a specimen of it, in the amorphous or non-crystalline state, by mixing together two chlorides of iron—the protochloride and the sesquichloride—in such proportions that when an alkali is added to remove the chlorine, the two oxides shall be precipitated conjointly. When they are thus thrown down in contact with each other they unite, and form magnetic oxide of iron. We have, then, one mode of its production in the wet way—a very ordinary mode. Here is some of the same compound—(in fact, I might call it a salt)—which we have dried; and you see that it can be taken up by the magnet immediately. We have here clear evidence of the artificial formation of this oxide of iron in an amorphous condition. Here is the specimen to which I referred on the last occasion as a furnace product occurring in a form which is exceedingly rare. I have only found it once at present. It is in the form of rhombic dodecahedrons. The ordinary form of this product is the regular octahedron. We have, then, positive proof of the formation of this compound by the dry way. It is produced by the action of steam on metallic iron, and sometimes you obtain it thus in fine crystals. It is produced also by the roasting of carbonate of protoxide of iron. Roasting operations of this kind are very extensively performed in this country. The iron ores from our coal measures are all carbonates of iron, and before they are introduced into the furnace they are roasted. During this process we frequently discover in the roast heaps fine crystals, or tolerably fine crystals, of magnetic oxide of iron. Again, this oxide is not unfrequently produced in fine crystals in various furnace operations, as in the conversion of pig-iron into malleable iron in the puddling furnace. It is produced when sesquioxide of iron, that is, the red oxide, is exposed to a high temperature, oxygen being then liberated, and magnetic oxide of iron being left. When silicate of protoxide of iron is exposed to a high temperature in admixture with carbonate of lime, or lime, the silica is displaced, forming silicate of lime, and magnetic oxide of iron is produced. This experiment we owe to the late Professor Ebelmen, who conducted it in a porcelain furnace at Sèvres, of which he had charge. Crystallised magnetic oxide of iron may be formed by heating chloride of calcium with sulphate of protoxide of iron—common green vitriol, in a covered crucible. Kuhlmann obtained it in that way. It is produced also by the action of the vapour of fluoride of iron on molten boracic acid. This result we owe to Mitscherlich.

There is one observation of Becquerel which should not be omitted. He found that on an iron bar from the foundation of an old castle which had been under water there were three layers. The outermost layer consisted of hydrated sesquioxide of iron; the second of anhydrous or red oxide; and the third, or innermost, of magnetic oxide. The layers of red oxide and magnetic oxide were distinctly crystallised.

Magnetic oxide of iron occurs abundantly in nature, forming in some places truly mountain-like deposits. This is the case at Gellivara in Lapland. We have very fine specimens of the ore at Arendal in Norway, in various localities in Sweden, in the Ural, and in Canada. It occurs in enormous masses, and also in beds. Sir William Logan, in his description of the minerals of Canada, has given an account of several very large beds of magnetic oxide of iron. He says they present exactly the appearance of stratification, and this appearance occurs also in other districts. Some of the beds are of enormous thickness. One to which he refers is twelve feet thick. That is a very small bed comparatively. There are some 200 feet thick, and some much thicker even than that. At Arendal it occurs in granite and in gneiss, along with augite and garnet. It is found also in serpentine in association with garnet, hornblende, and augite, as in Bohemia; in association with greenstone, granular limestone, garnet, hornblende, augite, and quartz, with augitic porphyry at Blagsdat, in the Ural; and in drusy cavities filled with crystals both of magnetic oxide of iron and iron pyrites. The association of these two minerals is worthy of note. It also occurs with calcspar and analcime. In Thuringia it is found in hypersthene-rock along with crystallised carbonate of iron. Another mode of its occurrence of extreme interest, as bearing upon the conditions under which it was formed, is its association with dolomite in Canada. Sir William Logan has described its dissemination in this substance. It is found also in basalt as at Taberg. The magnetic quality of certain basalts is supposed to be due to the presence of this magnetic oxide of iron disseminated through their mass. There is also another view—namely, that put forth some years ago by Professor Andrews, of Belfast, that some of these rocks contain metallic iron disseminated through them. When a portion of these rocks was pounded, and brought into contact with copper salts, metallic iron was thrown down, but I am not sure that Andrews's conclusion was actually a correct one. The magnetic oxide occurs also in lava at Monte Somma, in various sedimentary rocks, and in clay slates in France. There is a singular variety occurring in the lias beds at Rosedale and Pickering in Yorkshire. It is a very remarkable ore, containing a large amount of carbonate of iron. It has a dark bluish grey tint, sometimes more or less green, and it is not only magnetic, but frequently polar. I received this specimen of Rosedale ore from Professor John Phillips some years ago. It is perfectly amorphous. There is no evidence whatever of the crystals of which I have spoken. The magnetic quality of this iron ore in the north well deserves attention. Magnetic oxide is found in lodes in schist in Siegen. The lode is traversed by a dyke of basalt, and the sides of this dyke consist of magnetic oxide.

We see, then, that this remarkable compound, which so abounds in nature, occurs under very dissimilar conditions. Opinions are diverse as to the mode of its formation. Some stoutly maintain that under all circumstances it has been formed by igneous action, and injected or ejected like a volcanic rock; but there are in many cases some serious objections to this view. I am not prepared to say that magnetic oxide of iron in nature has never been the result of igneous action. I feel perfectly sure that in some cases it has been produced in that way. Its occurrence in lava, for instance, establishes this fact. But there is one point in connexion with some of these deposits of magnetic oxide of iron which demands particular attention in connexion with this igneous theory—namely, the presence of free silica in it. I have mentioned some cases in which free silica exists in the magnetic oxide of iron and various silicates. It is impossible to conceive that at a high temperature silica and magnetic oxide of iron could ever have come in contact without immediately combining and forming silicate of iron, the oxide of iron having a very strong affinity for silica. Even when magnetic oxide of iron is heated with silica, some of the oxygen is pretty readily displaced—the excess of oxygen beyond that required to constitute protoxide, and the silicate of protoxide of iron is formed. Thus, the presence of free silica in these deposits of magnetic oxide of iron is, I think, a strong proof that there, at least, it could never have been the result of igneous action. So, also, with regard to some of the silicates occurring in association with the magnetic oxide of iron in various deposits. There is no doubt, I think, that combination would have taken place between them and the oxide of iron to a much greater extent, at all events, than is the case. On the other hand, there are cases in which, in all probability, the oxide of iron has been, or may have been, injected. The mode in which this substance has been deposited in the amorphous state is very curious, and is at present, I think, very obscure. I cannot clearly understand all the conditions under which it has been formed. Undoubtedly, it has been derived in a great measure through the carbonate of iron there existing. I shall again have occasion to recur to some of the iron ores in which an oxide of iron resembling the magnetic oxide is present. When occurring in dolomite, the magnetic oxide must have been formed in the wet way. On the last occasion I showed you large and magnificent octahedral crystals in chloritic schist; and here, again, I think there is no doubt whatever that it must have been formed in the wet way. Its occurrence, also, in certain localities in a distinctly stratified state is suggestive of its aqueous origin under these conditions.

We now pass on to the consideration of the silicates of iron.

Anhydrous silicate of iron—silicate of protoxide of iron—is a frequent product of metallurgical operations. It occasionally occurs in beautiful crystals. I spoke of it on a former occasion under the head of iron chrysolite or olivine. I have here on the table numerous crystals of it which have been produced during metallurgical operations. It is a tribasic silicate of protoxide of iron. It consists of three equivalents of the protoxide, and one of silica—$3FeO,SiO_3$. The oxygen of the silica, therefore, is just equal to that of the base, and that is the most stable compound. We have made many experiments upon this of late. It has been supposed that higher silicates exist, some containing four or five or six equivalents of base. We have in every case failed to make them. In some experiments a quantity of oxide of iron and silica were mixed together in the proportion to form these higher silicates; and certain products have been obtained by means of heating such mixtures in crucibles. It has been supposed that true and definite silicates have been thereby formed. There is, however, an error in the mode of conducting the experiment when we attempt to make a more highly basic silicate than the one the formula of which I have given. We have conducted the experiments in iron crucibles, as clay crucibles cannot be used for this purpose. By fusing the silica and the oxide of iron together at a high temperature they unite and become suddenly liquid. If there be more oxide of iron than is sufficient to form that tribasic silicate, on attempting to pour out the liquid we always get the tribasic silicate poured out, and there remains behind a comparatively infusible, or partly infusible, mass containing magnetic oxide. If we had left the whole mass to cool in the crucible we might have concluded that combination had taken place throughout, and we should, therefore, have been led into error. When we attempt to pour out the product mass we find that what appears molten consists of a mass partly molten and partly semi-fluid. It is important to note that artificially, at all events, we cannot make a silicate containing more base than that represented in the formula before you. This tribasic silicate of iron was reported many years ago to have been found in the Mourne Mountains, Ireland, by Dr. Thompson. He described it as a distinct mineral. I made most particular inquiry about it, and got a specimen which was said to have come from the same locality, but it turned out to be nothing more than a piece of slag of some kind.

I have already spoken of the action of silica upon sesquioxide of iron at a high temperature, stating how it displaces the excess of oxygen and forms silicate. This silicate of iron in the hydrated state we can produce by way of double decomposition. If, for example, we take silicate of soda and a protosalt of iron and mix them together, double decomposition occurs, and the silica goes down in combination with the oxide of iron. It has a dull greyish green colour which, I think, you will recognise here; it is very similar to that of the green sand of geologists which, in fact, is supposed to be due to a hydrated silicate of iron.

There is a silicate of sesquioxide of iron—not one of the most satisfactory minerals in the world—termed cronstedite.

The next compound of iron to which we shall direct attention for a few moments is one of considerable interest—namely, the phosphate of iron, or vivianite. There are several phosphates of iron. There is one consisting of two equivalents of protoxide of iron, and one of phosphoric acid, $2FeOPO_5$. It is formed by the direct action of phosphoric acid upon iron. There are various other salts, one of which is formed by the addition of common phosphate of soda to a solution of sulphate of protoxide of iron. This phosphate quickly becomes bluish grey on exposure to the air. It dissolves slightly in water containing carbonic acid. The degree of solubility has been determined in the laboratory upstairs some time ago. It corresponds to about 0·54 parts by weight in 1000 parts of water containing carbonic acid. There is a natural phosphate of iron known as vivianite, which is a mineral of great interest. It is of a blue colour, and is a pseudo-morph of another phosphate which contains variable proportions of sesquioxide of iron resulting from atmospheric oxidation. It contains the two oxides of iron protoxide and sesquioxide. It occurs beautifully crystallised as well as earthy and amorphous. You sometimes get the amorphous variety out of boggy ground where bones have lain for a very long time. I remember that some years ago, while they were making the railway in the meadows under Castle Bromwich, near Birmingham, very fine specimens of this kind were dug up out of the ground. They are of a pale bluish colour; and sometimes when old bones which have been interred for a long time are dug up, they are found to be more or less blue, owing to the formation of this phosphate. In an old mine in Upper Silesia a human skeleton was found, several of the bones of which presented, in the interior, crystals of vivianite and blue-grey spots. The mine had been worked in the thirteenth century, and it is not known how long the skeleton may have been there. Sandherger found in horses' teeth taken out of a boggy meadow, crystals of vivianite from one to one and a-half line in length. They were as clear as water, had a very bright lustre, and gradually acquired a smalts-blue colour by exposure to the air. My friend Dr. Müller has in his possession a fragment of bone of a sheep in which the internal cancellated part contains small, acicular crystals of blue vivianite having a remarkably bright lustre. This specimen was found near Schleitz, in Saxon Voigtland. According to Bischof, when a solution of carbonate of protoxide of iron in water impregnated with carbonic acid is mixed with a solution of phosphate of lime in the same solvent, and kept without access of air, turbidity occurs after a time, and is followed by the deposition of yellowish white phosphate of protoxide of iron. Colourless crystallised tribasic phosphate of iron, of the formula—

$$3FeO,PO_5+8HO,$$

has been found in Delaware. This was perfectly colourless at first, but it became blue or bluish grey on exposure to the atmosphere.

We now come to the carbonate of iron. This is an extremely important salt in a commercial point of view. It is carbonate of protoxide of iron. You have specimens of it here before you. Here is a lump of it more or less impure. Sometimes it occurs of great purity. These rhombic crystals consist of this substance. It is anhydrous, and consists of one equivalent of protoxide of iron, and one of carbonic acid. It occurs abundantly in nature, and is found in geological formations of nearly every age. It is decidedly our most important iron ore. It is that which occurs so extensively in coal measures. It crystallises like calcspar in the rhombohedral system. It then forms a mineral termed spathic ore, or sparry iron ore. The natural mineral almost always contains a large quantity of carbonate of protoxide of manganese, and generally, also, some carbonate of lime and carbonate of magnesia. The manganese plays a very important part with reference to the application of this ore in various metallurgical operations. The specific gravity of the native crystallised variety ranges from 3·7 to 3·92. Senarmont obtained it crystallised in the form of a greyish-white sand, hardly attackable by dilute acids; it remained nearly unchanged in dry air, and very slowly acquired a pale brown colour in moist air. He produced it by exposing a mixture of sulphate of protoxide of iron and carbonate of soda, or of protochloride of iron and carbonate of lime, in hermetically-sealed glass tubes, in the first instance to a temperature of 150 degrees centigrade, or beyond—that is, with the sulphate of protoxide of iron and carbonate of soda; and in the other case to a temperature of from 130 to 200 degrees during from twelve to thirty-six hours. The salt was darker in colour, and more permanent in the air, the higher and longer the duration of the temperature employed. The form of the crystalline mass was distinctly rhombohedral. It is obtained anhydrous when thrown down by the addition of carbonate or bicarbonate of potash or soda to a solution of protochloride of iron. A bulky precipitate of carbonate of protoxide of iron is obtained, which very rapidly absorbs oxygen from the air, becoming at first green, and afterwards brown.

Carbonate of protoxide of iron is slightly soluble in water, but the solubility is increased considerably by the presence of carbonic acid. In this state it exists in mineral or chalybeate waters.

We will now speak of the carbonate of sesquioxide of iron. Formerly, no such compound was believed to exist, but of late experiments have been made which show that there is some reason for admitting its existence. It is only prepared under certain circumstances, and is very easily decomposed.

Bischof states that the solubility in pure water of carbonate of protoxide of iron is as follows:—10,000 parts of pure water dissolve 28·09 of the precipitated carbonate in from three to four hours; and of the natural carbonate, commonly called sphærosiderite, the same quantity of water dissolves only 6·0755 parts. The mineral is dissolved more rapidly by the application of heat, but at the same time it is quickly decomposed. If the decomposition is such as takes place when carbonate of copper is heated to redness, there would be only liberation of carbonic acid; but the protoxide of iron has a very high affinity for oxygen, and at a high temperature it partially decomposes the carbonic acid, reducing it to carbonic oxide. Thus, when you heated carbonate of protoxide of iron to redness you get carbonic acid and carbonic oxide evolved; and, instead of protoxide of iron remaining, you get protoxide in association with a certain portion of sesquioxide.

The carbonate of iron occurs in beds and lodes, sometimes in enormous masses, as at Eisenerz, in Styria, and Stalberg, in Prussia. At Siegen, it occurs in lodes in clay slate. We have it in lodes in this country. I very well remember a lode at Alston Moor, Cumberland. It was not very pure, but it was in a lode, nevertheless. It occurs beautifully in Somersetshire; very fine crystallised specimens are obtained there. All our argillaceous iron ores, or clay iron ores, consist essentially of carbonate of protoxide of iron. These occur abundantly in our coal measures, and are the chief sources of iron in this country. The carbonate occurs also in the lias, oölite, wealden, and eocene. Not a very long time ago, when I was down in South Wales, I saw a large quantity of iron ore which had been dredged up by the fishermen at the Isle of Wight, and taken to Cardiff, and there sold at about 10s. a ton. The pieces were rounded by the rolling action of the water. It is a curious thing that fishermen should have been engaged in dredging up iron ore. There was a large quantity sold in this way. Sometimes in clefts in our coal measures we find beautifully crystallised carbonate of iron.

With regard to the conditions under which this carbonate of iron has been deposited in nature, it is certain that it must have gone down from water; but one condition which must have existed is the absence of oxygen to peroxidise the iron. That is perfectly certain. If you bring atmospheric air in contact with carbonate of iron dissolved by carbonic acid in water, you will most assuredly peroxidise the iron, and separate the carbonic acid.

I shall now present to you some remarks concerning the constituents of these important clay iron ores. They are, as I said, essentially composed of amorphous carbonate of protoxide of iron; but they always contain, in addition, carbonate of manganese, carbonate of lime, carbonate of magnesia, clay, and phosphoric acid in combination with lime, invariably, without any exception whatever. I think they also always contain a little sulphur, as bisulphide of iron. I have never seen it absent. They contain other occasional matters. We have made here a very large number of analyses of these carbonates of iron, almost all of which occur in this country. The work occupied some years, and was completed four or five years ago. I will go over the constituents again, lest I should have omitted any. These ores contain protoxide of iron in combination with carbonic acid. Sometimes we find a little sesquioxide of iron. Then there is protoxide of manganese, alumina, lime, magnesia, potash, silica, carbonic acid, phosphoric acid, sulphuric acid, bisulphide of iron, a little combined water, and a little organic matter, or sometimes even a large amount, as in the black band pyrites. Those are all. The silica exists in combination with alumina, and a small quantity of iron, forming clay. In fact, these ores are mixtures of impure carbonate of iron with clay. The clay has exactly the composition of fire clay. If we take fire clay and clay occurring in association with these ores and analyse them, we find they have the same composition; and what is singular, and what we were not exactly prepared to expect, is that when we dissolve these iron ores in dilute hydrochloric acid, as is commonly done, there remains behind an insoluble residue of clay, and the greater part of the potash which the ore contains, which varies in amount from 1 to 2 per cent., will be found in that insoluble residue.

All these clay iron ores are very much alike till we come to those which are found so extensively in Yorkshire and Northamptonshire, and which also consist essentially of impure carbonate of protoxide of iron. The Yorkshire variety apparently contains in addition some silicate of iron. We have examined with great care one from Cleveland. It has a green colour, and it contains in a state of combination silica in a gelatinous form, or silica which separates in a gelatinous form, which shows that it was in a state of combination, and, as far as we can make out, it is silica combined with protoxide and sesquioxide of iron. There are, however, difficulties in connexion with this subject which we are not yet able to explain. In this Yorkshire ore you will see a grey infiltration, not at all unlike what appears in the other specimen. The two are very much alike. You can hardly distinguish one from the other. It is these which, I think, contain silicate of iron; but that is a point requiring further investigation. This ore contains also beautiful little infusorial shells of silica, left by the action of the acid. One point of great interest, also, is that it contains the well-known mineral called anatase, which is oxide of titanium. This is the only case, I believe, in which that mineral has been detected in these ores. The ore was submitted to the action of acid, and the acid left small dark spots, which were submitted to Professor Miller, of Cambridge, and after being examined under the microscope were pronounced by him to be anatase. They were also determined to be anatase by chemical analysis, independently of the microscopic investigation. Titanium is very generally present in our iron ores, although we do not often detect it in our analyses, because it is very difficult to find it, yet it almost always makes its appearance in our blast furnaces, occurring in the hearths in the form of little red cubes. Mr. Riley has been lately examining fire clays with reference to the presence of titanium, and he says that in all our fire clays, without exception, he has succeeded in finding titanium in the state of titanic acid.

I have spoken of the accidental occurrence of copper in our iron ores. It occurs in the form of copper pyrites. I have also referred to the presence of blende, or sulphide of zinc. Sulphide of nickel is occasionally found, especially near Merthyr, and it forms some of the most beautiful crystals you could wish to see—delicate hair-like crystals, called "Haarkies" in German, or Millerite in English geological nomenclature, so christened by Mr. Brooke after Professor Miller, of Cambridge. I have spoken of the occurrence of lead, and shown you specimens of it. There is also another metal of considerable interest which occurs in these ores—namely, silver—the last thing you would expect to find there; but Mr. Dick, on examining some of the black-band ore from New South Wales in the laboratory above some years ago, got evidence of the presence of silver. It has been extracted from the ore by the wet as well as the dry way. The proportion is about half-an-ounce to the ton. We find occasionally a peculiar fat-like body, containing a very large amount of carbon—namely, hatchettine—in some clay iron ores, especially in South Wales, where it occurs along with Millerite.

These impure carbonates of iron have undoubtedly all been deposited as so much fine mud under conditions in which oxygen was certainly excluded. There are many ways in which we might possibly explain this condition—perhaps the evolution of carbonic acid abundantly, carburetted hydrogen, and so forth; but oxygen there could not have been, because the carbonate of iron would most undoubtedly have been converted into sesquioxide of iron. Here is a specimen illustrating that change, upon which I have dwelt already. It is a piece of clay iron ore picked up from the coast at Hastings, having fallen out of the cliff. You will find that the whole of it has become coated with hydrated sesquioxide of iron, the carbonite of protoxide having disappeared, and the protoxide having been peroxidised. Here is a specimen of Cleveland ore, which is greenish grey, or greyish green in the interior, and which consists chiefly of carbonate of protoxide of iron, mixed with the so-called greenish silicate. By weathering action, it has become coated with this very unattractive deposit of hydrated sesquioxide of iron. As we get further down we find sometimes pure carbonate of protoxide of iron, or the impure variety—common clay iron ore, in fact; and occasionally we get beautiful specimens containing a nucleus of clay iron ore, surrounded by hydrated sesquioxide such as you have there. There is a very singular variety of clay iron ore here. There is a curious story connected with this lump of mineral, though it is not at all attractive to the eye. It was raised in Wales some time ago, and thrown away by the miners as worthless. It was put upon the pit-mounds as of no value; but it turned out to be a valuable iron ore, containing about 30 or 40 per cent. of iron. At first it was sold at about a shilling a ton; but its value soon became recognised, and its price went up to something like thirteen or fourteen shillings a ton.

ACADEMY OF SCIENCES.

March 28.

M. **Kuhlmann** continues his "*Researches on the Preservation of Building and Ornamental Materials.*" The present part is occupied with further details on the nature of the colouring matters of minerals. The author notices accidental changes of colour in Roman buildings from the presence in the mortar of sesquioxide of iron, which, becoming dissolved by rain water and carbonic acid, penetrates the marble or travertin, and is again deposited as the carbonic acid escapes. The contact of iron clamps, he notices, will also occasion the colouration of stones. Besides these accidental colourations, natural changes of colour result from the slow decomposition or oxidation of colouring matters. Organic matters will disappear, oxides in a low state of oxidation will pass to a higher, and in stones buried in the ground reduction will take place, &c. The slow decomposition of silicate of iron will also cause the production of yellow stains in porous siliceous stones. M. Kuhlmann believes that we have still much to learn respecting the colouring matter of precious stones, and he proceeds to explain a simple and expeditious way of analysing silicious stones, which will afford the means of recognising the true cause of colouration. He calls it analysis in the gaseous way, and it consists in passing dry hydrofluoric acid over the mineral heated to dull redness. The apparatus used is made of platinum. It consists of a retort in which to generate the gas, a tube to hold the boats containing the mineral, tubes to connect these, and finally tubes to carry the vapours to a caoutchouc bottle furnished with a little water. The volatile fluorides condense in the bottle, while most of the metallic oxides associated with the silica remain in the boat in the form of fluorides. Fluoride of iron, however, is volatile, and must be looked for with the fluoride of silicium. This method of analysis, M. Kuhlmann says, possesses immense advantages over the processes commonly used. By means of it he has proved that no metallic oxide exists in the amethyst, that hot hydrofluoric acid decolorises emeralds and yellow quartz, but does not change the colour of smoky diamonds, yellow diamonds, or rubies, while it turns blue sapphire violet. (The author must be spending a fortune in precious stones.) Lastly, M. Kuhlmann states that red cornelian, which is decolorised both by oxidising and deoxidising agents, and which, therefore, be formerly considered to be coloured by organic matter, leaves a ferruginous residue in the platinum boat when treated by the foregoing process—an apparent indication that the iron is present in the mineral in a peculiar state of oxidation or molecular engagement.

A report on two memoirs by M. Domeyko was read. They related to the composition of the aerolites found in the desert of Atacama, and to several new minerals found in Chili. The aerolites of Atacama consist invariably of nickeliferous iron with an admixture of olivine. Among the new Chilian minerals some are of great interest. There is one an *oxy-chloroiodide of lead* which forms an amorphous crust upon galena. It has the composition—

Oxide of lead	47·1
Chloride "	22·8
Iodide "	18·7
Various matters	9·5
	98·1

which may be represented by the formula—

$$2Pb(Cl_2I)3PbO.$$

The industrial importance of a mineral containing 10 per cent. of iodine is great, if the quantity obtainable be considerable. The author also found two new amalgams—Ag_6H, and Ag_5H_2.

A note by Signor Bechi on the *Boraciferous Soffioni* of Tuscany makes known the existence of a new mineral, to which the author has given the name of *Boussingaultite.* It consists of a hydrated sulphate of ammonia, in which part of the base is replaced by magnesia and protoxide of iron.

M. J. A. Poumarede sent a communication in which he proposes to use the vapour of zinc as a reducing agent in some metallurgical operations. Chlorides and fluorides, for example, can be easily reduced by this process. The apparatus consists of two crucibles, one resting within the other, into the lower of which the zinc is placed, while the other contains the metallic compound to be reduced. The two are arranged so that the vapour of zinc is brought in contact with the metallic compound. In this way the author has obtained beautiful specimens of crystallised iron, cobalt, and nickel.

CHEMICAL SOCIETY OF PARIS.

February 26.

M. Ad. Wurtz *in the Chair.*

M. **Paul Devissne** was elected resident member.

M. **Bonis** presented to the Society, on behalf of M. Jacquelain, a small work, entitled "*General Method for the Analysis of Fresh Water.*"

M. **Wurtz** gave an account of his researches on allyle. When this compound is heated with idriodic acid it combines either with one molecule of this acid to form a monohydriodate $\text{Є}_6\text{H}_{10},\text{HI}$, boiling at about 166°, or with two molecules of idriodic acid to form a di-hydriodate of di-allyle

$$\text{Є}_6\text{H}_{10}\left\{\begin{matrix}\text{H}_2\\ \text{I}_2\end{matrix}\right.$$

which is not volatile without decomposition. M. Wurtz has obtained acetates and hydrates corresponding with these hydriodates. He described the composition and the properties of these bodies, and in particular of the dihydrate of di-allyle

$$\text{Є}_6\text{H}_{10}\left\{\begin{matrix}\text{H}_2\\ (\text{H}\Theta)_2\end{matrix}\right.$$

which is identical or isomeric with hexylglycol $\text{Є}_6\text{H}_{14}\Theta_2$. He added that in these experiments allyle behaved like a hydro-carbon of the series $\text{Є}_n\text{H}_{2n-2}$. He had also satisfied himself that allyline combined in a similar manner with idriodic acid.

M. **Wurtz** presented a paper by M. Hugo Müller, "*On the Synthesis of Malonic and Succinic Acids.*"

M. **Oppenheim** remarked that the formation of hydriodate of phosphuretted hydrogen, which he had already laid before the Society, would admit of two interpretations. He did not admit the decomposition of water.

This communication gave rise to a discussion, in which MM. Oppenheim, Berthelot, and Personne took part.

PHOTOGRAPHIC SOCIETY.

Tuesday, April 5, 1864.

After the Minutes of last meeting were read and confirmed,

Mr. **Brothers**, of Manchester, exhibited a series of pictures taken by means of the magnesium light.

A portrait in enamel of the Lord Chief Baron was exhibited by Mayall.

Some transparencies on opal glass were also exhibited; also, some photographs by Cooper's method, and a picture on which the opinion of the Society was requested as to whether it was a photograph or not.

Mr. **Swan** then read a paper "*On the Improved Method of Carbon Printing.*" He first pointed out the defects of the silver process, the great fault being liability to fade; this, in fact, was the great blot on the fame of the art. In quest of processes by which permanent pictures could be produced, carbon was naturally thought of, and many attempts had been made, with more or less success, to employ this substance for the purpose; but there were objections to the processes proposed—either they were not perfect, or too troublesome to be practically employed. Mr. Swan, however, had been able to surmount the difficulties and to produce good results. The principal improvement consisted in the employment of a tissue which was transparent and pliable to replace the paper ordinarily employed. The manner in which this tissue is prepared is as follows:—Pour some collodion over a glass plate, and let it dry; then pour over the film of collodion a warm solution composed of the following ingredients: one part of bichromate solution (containing one of salt to three of water), two parts of gelatine, one part of sugar, and eight parts of water. To this mixture is added colouring matter, composed of Indian ink, to which may be added indigo and carmine. The tissue, after drying, is removed from the glass and placed under the negative, so that the light passes through the collodion film, and reaches first the inner side of the gelatinous film. This is altered by the light in such a manner as to become insoluble in water, and it is important to notice that the interior part is first acted on, so that in those parts of the picture where half tints occur there will be a thin layer resting on the collodion rendered insoluble, while that remaining unacted on will be exposed so as to be easily removed. In the old methods of applying this process the outer surface of the gelatinous layer was first thickened, and in consequence preserved a layer beneath, which could not be reached by the solvent without breaking the film, so that the half tints either remained dark, or, the coating being entirely removed through fracture, they became like high lights. In the new method the thickness of coagulated coating is exactly proportioned to the depth of colour. After exposure under the negative, which only requires a third or fourth of the time necessary for paper prepared with silver in the ordinary manner, the film is fastened to a sheet of paper by means of starch or a solution of india-rubber, and placed in water at 100° F. A few minutes suffice for the purpose, but it is better to allow the picture to remain three or four hours in the bath, brush it lightly with a camel's hair brush to remove any adhering pigment, and then expose to a stream of water, allow to dry, and mount. With reference to the time of exposure, it was to be remarked that a little variation in this respect was not nearly so important as with silver prints, and over exposure could be remedied by long washing with hot water; but Mr. Swan thought it would be very advantageous to have some better means of regulating the time of exposure than that at present employed, and suggested the use of a photometer for the purpose. In order to avoid the inversion of the image, the print might be mounted face downwards, and the supporting paper afterwards removed by benzol; or the reversal could be avoided by removing the negative from the glass before printing by means of gelatine. With respect to the colouring matter, various substances had been tried. Carbon produced by the action of sulphuric acid on sugar had been proposed, but found to be too flaky, and the same objection applied to lamp black, but various colours might be employed. Mr. Swan expressed his conviction that the process was practically applicable on a large scale. With respect to the patenting of the process, he had at first thought of putting no restriction on its application, but it afterwards occurred to him that, since it would probably be employed commercially, it would be desirable to participate in the profits accruing from its adoption, but he did not wish to prevent its employment for any scientific purpose.

The **Chairman** remarked on the perfection of the prints, and returned thanks to Mr. Swan in the name of the Society.

In answer to a question by a Member as to what part of this process was claimed as original, Mr. **Swan** replied that the tissue was the principal novelty, its transparency being such that the light passed through it without serious diminution, and, consequently, the printing could be performed by allowing the light to traverse the collodion film, and reach first the interior of the gelatine film. The Chairman drew attention to the results obtained, which certainly surpassed any previously laid before the Society.

In reply to various other inquiries, it was stated that the application of the process to engraving was still under consideration, but that there was every promise of success, that the object of the collodion film in the tissue was to hold the picture together, for otherwise it would fall to pieces in washing; that the short time of exposure necessary in printing might be due to the presence of sugar, but experiments had not been made on this particular point; and that a better print could be obtained from imperfect negatives than by the silver process.

Dr. Diamonn, of Edinburgh, remarked on the applicability of the process to enamel painting, since any pigments could be mixed with the gelatinous coat.

Mr. How exhibited a photographer's tent, of which the chief recommendations were its compactness, lightness, and the arrangements of its fittings, all of which were exterior.

Royal Institution.—Tuesday, April 12, at three, Professor Helmholtz, "On Conservation of Energy." Thursday, April 14, at three, Professor Helmholtz, "On Conservation of Energy." Friday, April 15, at eight, Professor Abel, "On Gun-cotton." Saturday, April 16, at three, Prof. Frankland, "On the Metallic Elements."

Respiration of Fruits.—M. Cahoure has made an examination of the respiration of fruits; he considers that the fruit is one of the most important organs of vegetables, and that the examination of respiration should be by no means confined to the green part of the plant. He has endeavoured to study the proportion of gases contained in the parenchyma of the pericarp and their composition; the action of fruit upon the gas of respiration, *i.e.*, oxygen, whether alone or mixed with nitrogen; the action upon the same gas of each of the envelopes of the fruit and of its fleshy part when it exists. It was found that apples, oranges, citrons, in a state of maturity, placed under bell jars containing oxygen, or mixtures of oxygen with nitrogen, consumed a quantity of oxygen, and furnished an equal amount of carbonic acid, the proportion being greater in diffuse light than in darkness. It is effected gradually up to a certain point, beyond which it augments considerably, and the internal face of the skin presents some alteration. The amount of carbonic acid produced increases with the temperature. The fruit acts in the same manner during the time elapsing between its losing its green colour and its obtaining its maturity, and that of its obtaining its maturity and of its commencement of decay; but as soon as this has once commenced the amount increases rapidly. Determinations were made of the proportions of gases contained in the juices. To accomplish this, the fruit was squeezed under mercury, and the juice collected in a flask, to which was afterwards adapted a tube by a cork, but it was found that the same result was obtained if the juices were expressed in an ordinary press and afterwards placed in vessels. The gases were expelled by ebullition. Oranges, citrons, pomgranates, pears, and pippins gave quantities of gas diminishing in in the order of the names; the gas consisted of carbonic acid and nitrogen in various proportions, but no oxygen, hydrogen, carbonic oxide, or carburetted hydrogen was found. A ripe fruit enclosed in air was found to absorb hydrogen very rapidly, and if allowed to remain until it became soft, the juice was found to contain a very large quantity of gas rich in carbonic acid, the air in which it was enclosed containing carbonic acid also. It is intended to examine the gases contained in the juice from the commencement of development to the time when it has attained its complete maturity.

NOTICES OF BOOKS.

The Industrial Resources of the District of the Three Northern Rivers, the Tyne, Wear, and Tees; including the Reports on the Local Manufactures, read before the British Association in 1863. Edited by Sir W. G. Armstrong, C.B., F.R.S., &c. &c., J. Lowthian Bell, Esq., John Taylor, Esq., and Dr. Richardson. Illustrated with Maps, Plans, &c., &c. Newcastle-on-Tyne: A. Reid. London: Longman and Co. 1864.

The meeting at Newcastle will long be remembered as one of the most successful gatherings of the British Association; and it will not be forgotten how great an interest was given to the proceedings by the valuable papers on the local industries now collected in this volume, and here illustrated by maps, plans, and engravings, with a profuseness we have never seen equalled. The volume as it lies before us may be taken as a pattern of what we could wish to see done for every similar district in the United Kingdom.

A complete account of the industrial resources of the Kingdom has yet to be written; but to compile and digest it would be beyond the labour of even a Macculloch. The work could only be produced by the co-operation of several heads and hands, as in the present instance; and, in the absence of the complete work so much to be desired, we hope to see the visit of the British Association to every centre of industry result in the production of such a local record.

Abstracts of many of the papers contained in the volume appeared in our pages shortly after the meeting, and we need not again refer to them. But the illustrative maps and engravings scattered so profusely through the pages of this volume give it a lasting and peculiar interest which the mere papers, valuable as they were, could not possess.

Appendices have been added to the papers which give manufacturing details it would have been impossible to supply in their original form. We turn, for example, to the paper on the Chemical Manufactures of the Tyne, which our readers will find at page 124, vol. viii. of the Chemical News. In that paper some of the most recent improvements in the manufacture of soda were attended to, particularly the revolving furnace of the Jarrow Works, and the method of condensing hydrochloric acid adopted so successfully at the Walker Alkali Works. Now, among the appendices to the paper included in this volume, we find descriptions and drawings of both these improvements, which may be of great service to manufacturers. Besides this, these additions to all the reports will be found to contain much original matter, published for the first time, and sometimes drawn from out-of-the-way sources. There is, for example, an interesting account of jet, from which we extract the first sentence:—"This material takes its name from a river in Lycia, which was called Gages in the time of Pliny, and the small pieces of jet obtained in that locality were called *gagotes*, afterwards corrupted into *gagat*, and ultimately into *jet*." We shall not dispute this etymology, the authority for which is not quoted, but we always supposed that *gagates* were agates.

Some curious information will also be found in the reports on the manufacture of paper and of glass. But the more solid information is not wanting, and we heartily recommend the book to our readers, at the same time thanking the authors and the Newcastle publisher for the richness and excellence of the illustrations, which must have been produced at a very considerable cost.

British Pharmacopœia.—The cheaper edition of the Pharmacopœia is now announced as ready. Owing to a press of matter, we are compelled to postpone our notices, which will be resumed in our next number.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

280. John Hawkins, Walsall, Staffordshire, and Charles Hawkins, Selly Oak, Worcestershire, "Improvements in the manufacture of gas for illumination and other purposes, and in apparatus connected with the same."—Petition recorded February 2, 1864.

399. Frederick Charles Phillip Hofmann, Wilmington-square, London, "Improvements in machines for crushing hard substances, for washing ores and minerals, and for separating earth and earthy matters from solid substances."—Petition recorded February 16, 1864.

408. Henri Newmane, Hortulau Villas, Shrewsbury, Shropshire, "A new medicinal compound pill for diseases of the liver."—Petitions recorded February 17, 1864.

418. Laurent Stanislas Naudin, Rue de la Savonnerie, Rouen, France, "Improvements in the preparation and composition of a substance for soldering silver or other metals."

419. John Travis, Luzley Brook, Royton, Lancashire, "An improved method of preventing and curing corrosion and preserving the metal in steam boilers, steam generators, and fuel economisers."

424. François Maria Aubert de Tregomain, Stamford Street, Surrey, "Improvements in rendering firewood and other materials more combustible, and also impervious to air and moisture."

431. John James Chidley, Glaskin Street, Hackney, London, "An improved method of stoppering or rendering air-tight bottles and jars."

432. Frederic John Arnold, Adam's Court, Old Broad Street, London, "Improvements in apparatus for producing and burning combustible gases for heating and lighting purposes." — A communication from Thomas Arnold, New York, U.S.

435. Robert Scrivener, Hanley, Staffordshire, "Improvements in the preparation of clay and other plastic materials used for manufacturing purposes, and in drying materials manufactured from the same."

436. William Charles Page, Millwall, Poplar, Middlesex, "An improved composition for coating ships' bottoms."

446. Alfred Vincent Newton, Chancery Lane, London, "An improvement in photography."—A communication from George Garnier White, New York, and Charles Alden, Newburgh, New York, U.S.

452. John Sanders, jun., Upper Hockley Street, Birmingham, "A new or improved gas regulator for controlling or regulating the flow or pressure of gas required to be used for illuminating purposes."

454. Eugene Alphonse Cotelle, Bouvelart St Martin, Paris, "An apparatus for concentrating and distilling sulphuric and other acids, and all solutions in general."

465. Francis Sorrel Claxton, Imperial Foundry of Cannon, Ruelle, Charente, France, "An improvement in casting iron, brass, or copper over or around hollow cylinders of steel, iron, or other metal, using air, water, or other fluid for cooling the casting."

Notices to Proceed.

2762. William Henry Perkin, Seymour Villa, Sudbury, Middlesex, "Improvements in the manufacture of colouring matters, suitable for dyeing and printing."—Petitions recorded November 6, 1863.

2819. William Edward Gedge, Wellington Street, Strand, London, "Improved process and apparatus for amalgamating the precious metals."—A communication from Jean Baptiste Baux and Alexis Guiod, Passages des Petites Ecuries, Paris.

2866. Gilbert Thonger, Birmingham, "Improved modes of preventing accidents arising from the sale or use of poisons."—Petition recorded November 16, 1863.

3213. William Henry Tooth, Rhodeswell Road, Stepney, Middlesex, "Improvements in the manufacture of iron and steel, and in the machinery, apparatus, and furnaces used therein, and for the production and application of gas to be employed in such manufacture, and the application of parts of the said apparatus to the manufacture of glass and alkali."—Petition recorded December 19, 1863.

3246. James Ronald, Liverpool, "Improvements in, and apparatus for, the conversion of ropes and other cordage into oakum, tow, and paper-stuffs, parts of which are applicable to teasing and cleaning wool, or hair on skins, and dressing 'waste' tow, wool, hair, and other 'waste' fibres."—Petition recorded December 23, 1863.

372. William Drake, Sheffield, Yorkshire, "Improvements in the manufacture of iron."

2696. John Henry Johnson, Lincoln's-inn Fields, London, "Improvements in the manufacture of soap."—A communication from Jean Baptiste Vasseur, and Alexis Mahot, Paris.—Petitions recorded October 30, 1863.

2724. Guillaume Ville, Paris, "Improvements in treating natural phosphates of lime for agricultural purposes."

2803. Dan Dawson, Milnsbridge Chemical Works, Huddersfield, Yorkshire, "Improvements in the production of colours for dyeing.—Petitions recorded November 11, 1863.

3168. Henry Chadwick, Topsham, and John Clench, Exeter, Devonshire, "Improvements in utilising the waste liquors resulting from the preparation of fibrous matters in paper pulp making, and in the machinery or apparatus to be used therein."—Petition recorded December 15, 1863.

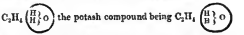
7. Charles Martin, Brentford, Middlesex, "Improvements in the treatment and preparation of materials for the manufacture of paper, and in the construction and apparatus employed therein."—Petition recorded Jan. 2, 1864.

488. William Edward Gedge, Wellington Street, Strand, London, "Improvements in the composition and manufacture of artificial granite, marble, and stone, and in the kilns and apparatus used in such manufacture."—A communication from Jean Begué, Faubourg St. Martin, Paris.—Petition recorded February 27, 1864.

Origin of Species.—A work has just been published by M. Flourens, entitled, "Criticism of the Book of M. Darwin upon the Origin of Species."

Citrate of Iron and Magnesia.—This preparation is made as follows:—The hydrated oxide from three and a-quarter ounces of persulphate of iron is dissolved in three ounces of citric acid, and the solution is then completely saturated with carbonate of magnesia. The solution is afterwards filtered and evaporated to a proper consistence, and sealed in the usual way.—*Neues Repert für Pharmacie*, bd., xii., s. 442.

New Acid Isomeric with Sulphovinic Acid.—Mr. A. B. Northcote has accidentally discovered a new acid isomeric with sulphovinic acid; it was obtained by adding sulphuric acid to an alcoholic solution of potash which had been kept for some years. The potash salt crystallises in long prisms, colourless and transparent. It differs from isethionate ordinary sulphovinate, but may be parathionate. The discoverer thinks it probable that the potash, by its powerful affinity for water, alters the molecular arrangement of the alcohol, the altered body being represented in symbols in the following manner:—



$C_2H_4 \left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)$ the potash compound being $C_2H_4 \left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)$

This view is supported by the fact that the compound acid is formed without heat, whereas to produce ordinary sulphovinic acid heat is necessary.

CORRESPONDENCE.

Continental Science.

Paris, April 6, 1864.

The disease among silk-worms has raged to such an extent in France that it becomes a matter of great importance to devise some means of preserving the life of the worms for a sufficient length of time for them to form cocoons, and it is also desirable to obtain healthy eggs from other quarters. M. Guérin-Menneville says that great exertions are being made by the Government, and that the Minister of Agriculture has advised the préfets of the silk departments to make experiments on the process of Onesti.

Some eggs have lately been sent to France, overland, from China through the exertions of M. Simon, and have been distributed, some having been reserved for experiments; a fresh importation has also been made from Japan by M. Berlandier, and it is hoped that by these means the condition of the silk-producing departments will be ameliorated.

The causes of these curious epidemics are still shrouded in mystery; they make their appearance surreptitiously, increase until they reach a climax, and then wholly or partially disappear, as if they had become exhausted, and all their energy being consumed, they die a natural death. The silk-worm disease has for fifteen years raged in France, but it is to be hoped that the exertions now being made will lead to the discovery of some remedy. A slight change of climate, produced by a variety of possible causes, might be sufficient either to produce or remove one of these pestilences; and if this is the case, remedial measures are likely to be of little use until the disease itself shows symptoms of decline. Our knowledge on these matters is, however, daily increasing, and the advancement of science may in time put us in possession of the means of combating similar attacks.

An interesting notice concerning the flight of the eagle is inserted in *Poggendorff's Annalen* from Dr. Simmler. An eagle was observed to descend obliquely through a space of 40,000 Swiss feet in six minutes, which gives a velocity of more than thirty metres per second. When it is considered that this is a rate of more than ninety-seven miles an hour, and, in fact, exceeds the greatest speed of an express train, it becomes easily credible that sea birds may be caught by placing a board with a fish upon it in the water behind a boat, the bird darting with such force as to strike its bill right through the board.

A great blessing to mothers, and to children, too, although the latter are generally overlooked in these blessings—it being taken for granted, we must suppose, that the blessing is equal for both—has lately been discovered in the shape of a new cure for whooping-cough. The treatment is not severe, and does not include confinement to the house. Quite the contrary; it consists in going to a gas-works and breathing the vapours which arise from the lime purifiers. The relief is immediate, and two or three visits are sufficient to produce a complete cure.

The theory of Mr. Wheatstone of the acoustic figures produced on plates during vibration has been confirmed by a series of experiments by M. Rudolph Kœnig on plates of copper. He has only a remark on a detail of execution, which is as follows:—"Mr. Wheatstone says that if a given system of nodes could take successively every inclination with reference to a given axis, there would result upon a square plate an indefinite number of figures by a series of continual transformations; but experiment shows the contrary. It appears, then, that those figures alone are possible which are composed of primary vibrations, for which maxima of vibration coincide with the angles of the plate. This is not astonishing; for one always observes maxima of vibration at the two extremities of a free rod."

The question of the index of refraction of metals has been investigated, both theoretically and practically, by M. Quincke. The surfaces of metal employed were thin layers of silver deposited by the method of M. Foucault on a plate of polished glass. It was found that the index of refraction of metals decidedly increases with the angle of incidence.

With reference to an observation in Dr. Tyndall's work on "Heat Considered as a Mode of Motion," that it would be interesting to see whether the balls of rifled guns would not show signs of fusion, M. Schrœder remarks that he once made an experiment bearing on this subject, with the object of ascertaining the changes that zinc underwent when heated to various temperatures. He found that at a temperature above boiling water it became granular, and that if the heat was very gradually increased, the metal would, without losing its form, assume exactly the appearance of zinc that had been melted. By having a ball constructed of zinc, he thinks it would be possible to estimate the amount of heat given out on striking the target. An experiment of this kind might furnish some information, but the determinations of temperature would not be very accurate, and it would probably be possible to discover a more certain way of estimating the heat given out by the concussion; at the same time, the suggestion is useful in the absence of a better measure of temperature under the conditions of the experiment.

The art of photography has recently been applied to a useful purpose—namely, to assist in the investigations of physical geography and geology. The benefit afforded by it to these two sciences will be great, and affords an instance of the influence which arts and sciences have over each other; no single one making an advance without carrying the others with it. In the first beginnings of photography there was but little promise of the perfection to which it would ultimately attain, but it gradually advanced by slow steps to its present state of perfection. The advantages it will confer on the two sciences mentioned are evident; by its means the geographer and geologist will each be able to compare together different parts of the earth's surface, with a view to the prosecution of the study of their respective sciences in a much more efficient manner than could be done by means of mere descriptions, and the labour of producing the representations will be much less than that required for the productions of an artist, and will be more appropriate for the ends to be attained, the rigid accuracy in the smallest details which is to be found in photographs being an important point. A great advantage would be gained if not only the outward forms but also the internal structure of geological objects, such as shells, &c., were recorded by photography. By this means a comparison could be made with much greater facility and with less fatigue than by viewing the objects necessarily in the microscope; the prepared paper replacing the eye in this fatiguing operation.

Photography has already produced its effects in the advancement of other sciences and arts. Astronomy has benefited greatly, and the observations necessary for the prosecution of this science are performed with much greater accuracy by its help. It promises to be of great service in the art of lithography, and although there are many sciences that as yet do not seem to be much affected by its presence, there is no telling what may happen hereafter; for instance, it is quite possible that quantitative analysis may hereafter be accomplished by its assistance. To take an example: there is a method of determining the amount of copper in a solution by diluting it until it has the same colour as a standard solution of known strength. The inaccuracy of this process depends upon the difficulty of determining by means of the eye alone the similarity of colour in the two liquids; but if the comparison were made by means of photography; or, perhaps, in this particular instance, since blue is a colour which would not offer facilities of measurement by photography, photometry could be used instead, great accuracy might, perhaps, be insured. In the case of any other colour but blue, photography might be employed to estimate the depth of colour, but it is not wished that it should be understood to be asserted that these processes are at present applicable to quantitative estimations, but only that they might become so, and might offer advantages of speed, and even accuracy, over the present processes. There are but few chemical substances that cannot be made, under some circumstances, to yield coloured solutions, and this is all that is necessary for the application of the process.

In such a manner as this it is that sciences mutually assist each other, the improvements in one necessitating improvements, and bringing to light and necessitating the removal of imperfections in the other, an incessant but gradual advance being thus made; and this applies equally to all branches of knowledge, so that, step by step, an incessant advance towards perfection is made.

On a Peculiarity Resulting from the Presence of Phosphorus in Iron Wire.

To the Editor of the Chemical News.

Sir,—Upwards of twenty years ago it was stated by Griffin, in his "Chemical Recreations" (Ed. 8, p. 154), that thin iron wire exhibits in burning a green light. This statement is repeated by Professor Galloway in his useful little work on "Chemical Analysis;" iron wire at least is placed in that manual (Ed. 3, p. 209), amongst the substances which impart a green colouration to the blowpipe-flame. It is curious, on the other hand, that neither Berzelius, Plattner, Scheerer, Lenz, Bruno Keel, nor any other of the numerous workers with the blowpipe on the Continent of Europe have ever alluded to this reaction.

Struck by this apparent omission, I have lately examined a considerable number of iron wires by the blowpipe. I find that all the light-coloured and comparatively hard wires exhibit the reaction very distinctly—a bright green flame streaming from the point of the wire during the oxidation and fusion of this, whilst a rapid scintillation or emission of sparks accompanies the phenomenon. The dark and soft wires, on the contrary, fuse much less readily, and do not occasion any colouration of the flame.

On investigating the subject more fully, I have discovered that the green colouration is due to the presence of a minute amount of phosphorus in the hard and light-coloured wires. During the combustion or oxidation of the wire, the phosphorus becomes converted into phosphoric acid, and thus occasions the colouration of the flame.

As iron wire is often employed in blowpipe experiments as a reagent for phosphoric acid in mineral bodies, and as it is also occasionally used in the estimation of phosphorus in cast iron (Regnault, *Chemie*, iii., 127), the publication of this note may not be without its use.

I am, &c., E. J. Chapman.

University College, Toronto, Canada, March 17.

MISCELLANEOUS.

Formation of Cell-Wall.—Vegetable histology attracted of late years considerable notice. Herr Schacht has been examining into the formation of the primordial utricle, with a view to discover what light they might throw upon the formation of the cell-wall. At an early stage in the development of the embryo, numerous currents were observed in the protoplasm, and afterwards a network of threads of cellulose, corresponding to these currents, are found, resulting from the gradual change of the protoplasm itself; these continue to increase in thickness. This formation is considered analogous to that of the outer layer of the primordial utricle from the inner layer of the same; the various modifications are also explained by the supposition of the existence of currents. The gradual formation of cellulose threads in this manner is considered conclusive against the theory that the cellulose wall is a secretion of the primordial utricle.

New Pharmacy Bill.—The following are the heads of a bill now under the consideration of the Council of the Pharmaceutical Society:—

After the 1st of January, 1865, no person to keep open shop for dispensing the prescriptions of duly qualified medical practitioners unless registered as a Pharmaceutical Chemist under the Pharmacy Act, or as a Chemist and Druggist under this Act. Examination established for all who commence business after that date.

Examiners under Pharmacy Act to be the Examiners under this Act.

Registrar under Pharmacy Act to be the Registrar under this Act.

Chemists and Druggists in business in Great Britain before 1st January, 1865, entitled to be registered as Chemists and Druggists, on payment of a fee not exceeding one guinea, and saving to them all their existing rights.

Assistants and Associates under Pharmacy Act, who have passed Minor Examination, to be registered as Chemists and Druggists on commencing business.

Council of Pharmaceutical Society to make orders for regulating Registers to be kept.

Duty of Registrar to make and keep correct Register.

Evidence of Qualification to be given before Registration—of Examination on the part of those who enter business after said date;—of having been in business before said date by others.

Annual Register to be published and be evidence.

Penalty on wilful falsification of Register.

Penalty on obtaining registration by false representations.

Penalty on falsely pretending to be a registered person, or keeping open shop for dispensing said prescriptions, not being registered.

Registered Chemists and Druggists, having passed Minor Examinations, may be elected as, and continue and use title of, Associate of Pharmaceutical Society, and may vote at Meetings of the Society.

Saving of rights of duly qualified medical practitioners.

Benevolent Fund may be applied to past Members and Associates, also to Pharmaceutical Chemists and Registered Chemists and Druggists.

Preservation of Wood.—The following composition is recommended to protect the bottom of posts, palings, and tubs set in the earth:—Forty parts of chalk are added to fifty parts of resin and four parts of linseed oil, melted together in an iron pot. One part of native oxide of copper is then added, and one part of sulphuric acid is cautiously stirred in. The mixture is applied hot with a strong brush, and forms, when dry, a varnish as hard as stone.—*Neues Jahrb. für Pharm.*, bd. xx., s. 235.

ANSWERS TO CORRESPONDENTS.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

T. M.—Just above the surface of the fluid.

W. B.—1. Consult the Index at the Patent Office, Chancery Lane. 2. Not that we are aware of.

G. C.—The process is a very old one.

J. F.—Toluidine is now to be obtained at the same price as aniline.

Erratum.—P. 167, col. 2, *for* "Iridium," *read* "Indium."

Received.—H. N. Draper; Gebs and Co.

Books Received.—Haselden's "Notes on the British Pharmacopœia;" "The Ophthalmic Review;" "Proceedings of the American Pharmaceutical Association, 1863."

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Analysis of the Harlow Car Waters, near Harrogate, by Dr. Sheridan Muspratt, *M.D., F.R.S.E., &c., Founder and Principal of the Liverpool College of Chemistry.*

About a mile and a quarter west of Harrogate springs are situated, which have, recently, been very much resorted to for cutaneous and other affections. A suite of handsome baths have been erected, also an hotel. They are delightfully situated on a gentle slope, and sheltered by surrounding plantations, combining altogether a most salubrious abode for an invalid. The waters of these springs were analysed by the late Mr. West, F.R.S., of Leeds, in the year 1844, but several doubts having arisen regarding his statements, at the suggestion of my friend, Dr. Bennett, of Harrogate, I have subjected furnished samples of the waters to a thorough investigation, and the results arrived at are certainly very different to those already published. Annexed are the tabulated numbers:

	Grains in the Imperial Gallon.	
	No. 1.	No. 2.
Carbonate of lime . .	10·498	10·501
Carbonate of magnesia .	1·002	1·347
Carbonate of soda . .	15·093	15·380
Carbonate of potassa .	traces	traces
Carbonate of iron . .		
Carbonate of manganese .		
Sulphide of sodium . .	2·352	3·543
Sulphate of magnesia .	4·593	3·831
Chloride of magnesium .	5·741	5·194
Chloride of sodium . .	1·006	3·513
Chloride of potassium .	trace	trace
Ammonia	trace	trace
Silica, &c. . . .	0·841	0·706
	41·626	44·015

Mean temperature of the spring 46°.

Mr. West gives only the annexed ingredients in his analysis, *videlicet*, carbonates of lime, magnesia, and soda, sulphate of magnesia, and chloride of calcium. He did not find *sulphide of sodium*. Now, it is upon this compound and the carbonate of soda that the therapeutic effects of the waters chiefly depend.

I have my misgivings as regards the presence of *free* sulphide of hydrogen in the springs. Dr. Bennett, as far back as 1843, wrote as follows:—"I have frequently examined our sulphur springs, both public and private, and I have never been able to detect free sulphide of hydrogen." This view I readily endorse with respect to the Harlow Car waters. They do not contain any of this gas in an uncombined state, and very little free carbonic acid. The waters of Harlow Car, on exposure to the atmosphere for a minute or two, evolve a faint hepatic smell, but this is the result of the decomposition of a metallic sulphide.

My friend, Dr. Hofmann, made a very elaborate and careful investigation of the medicinal waters of Harrogate in the year 1854. He states that the sulphide of hydrogen exists in those waters "partly free, partly in combination with metallic oxides. Only a portion can be expelled by boiling. We have not at present sufficient data to calculate with any degree of certainty the amount of sulphide of hydrogen which is free and that which is combined, and I have, therefore, introduced into the report the whole quantity in the form of sulphide of sodium." It is very dubious to me whether even in the Harrogate springs there is any *free* hydrosulphuric acid. Further researches may be able to settle this moot-point.

College of Chemistry, Liverpool.

General Theory of the Action of Affinity, by M. E. J. Maumené.

When two bodies are placed in presence of each other, and by the exercise of their affinity produce a chemical action, these two bodies obey laws of which hitherto we have no exact knowledge.

When sulphuric acid acts on a metal we see nothing else in general, in their reciprocal action, than SO_3 and M; and on subtracting HO the reaction is represented by the very simple formula—

$$M + 2SO_3 = MO,SO_3 + SO_2.$$

The most striking result of the reaction is in accordance with this uniformity, but it is not always the only one. With certain metals there is a certain varying quantity of sulphide; with others, a greater or less quantity of sulphur.[*]

But how to explain this *accident?* We have as yet no precise rule.

If we examine the action of nitric acid on metals, the accident becomes of greater importance. Whilst the concentrated acid gives a nitrate, or metallic acid, and no ammonia, the diluted acid gives more or less considerable quantities of the latter; and this is a serious accident, of which only a *soi-disant* explanation is given. Ammonia can proceed only from water, and water is truly said to determine its formation; but as concentrated acid contains water, why does it not produce ammonia?

I could cite many more instances. These facts may be easily explained; it is sufficient to consider exactly the true circumstances under which affinity is exercised, and then to apply well-known rules.

When we introduce into a retort one equivalent of copper and two equivalents of sulphuric acid, according to the formula given above, is it between these weights of matter that the affinity is exercised? Certainly, if the experiment is prolonged, as long as the disengagement of sulphurous acid (the most evident sign of the chemical action) can continue it is true that the whole of the chemical actions proceed from the two weights of matter; but how many chemical actions will there be? Between what bodies is the affinity exercised?

Between all the simple bodies contained in the vessel, that is to say, Cu,S,O and H, or if it be so desired between Cu,SO_3 and HO.

How is this affinity exercised? By determinable weights of matter, and not at all those with which the retort was charged.

In fact, it is a positive rule that chemical action is exerted only by contact, that is to say, at a distance infinitely small. Hence the action of copper Cu and sulphuric acid SO_3,HO can take place only between the molecules of the two bodies situated at very minute distances from the surface of separation.

Another and not less certain rule is, that all action is equal to the reaction. The action of copper on sulphuric acid is thus equal to the reaction of sulphuric acid on copper; and consequently the infinitely small distance to which the acting molecules of copper and acid extend is exactly the same on each side of the surface which separates them.

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[*] *Ann. de Chimie et de Phys.*, xviii., 311.

Consequently the chemical action is not exercised by the entire mass of the two bodies in the retort, but by equal and infinitely fine layers of the bodies.

Nothing is easier than to estimate the real weights of the matter between which affinity is exercised, for the weight of the two layers of equal thickness is in proportion to their density. If, then, we call

m the weight of metal of which the density is d,
a the weight of acid of which the density is d',

we get the proportion—

$$m : a :: d : d'.$$

On applying this formula we arrive at the clearest evidence as to the cause of the principal phenomena in our experiments, and of the other phenomena considered as accidents.

For instance, take sulphuric acid and lead, and we have—

$$m : a :: 11 \cdot 35 : 1 \cdot 85.$$

Choosing for m the equivalent of lead 103·5 (M. Dumas), and we shall find for a the real number of the equivalents of acid acting on this equivalent of lead—

$$103 \cdot 5 : a :: 11 \cdot 35 : 1 \cdot 85,$$

whence—

$$a = 16 \cdot 87,$$

and as—

$$\frac{49}{16 \cdot 87} = 2 \cdot 9 \text{ (2·904 exactly)},$$

the masses of metal and acid between which the chemical action commences are—1 equivalent of Pb and $\frac{1}{2 \cdot 9}$ equivalent of SO_3HO; or, which amounts to the same thing, 29 equivalents of Pb and 10 equivalents of SO_3HO.

We will examine what action ought to take place between the two masses.

Lead can act on sulphur and on oxygen, but not on hydrogen. We shall have, then:—

1. The affinity of lead for oxygen which may effect the decomposition of acid SO_3 and of water HO. This affinity, from which oxide of lead is formed, is favoured by the affinity of this oxide for the surrounding sulphuric acid, and is very powerful.

2. The affinity of lead for sulphur, which is itself very great, and is favoured by the concurrence of the preceding.

If the action of lead on oxygen is subtracted, we shall have—

$$29Pb + 10SO_3,HO = 29PbO + SO + 9S + 10HO.$$

The matters thus produced react almost immediately on the sulphuric acid in which they are immersed, and none of them can be identified.

If the action of the lead on the sulphur predominates, we have this other formula—

$$29Pb + 10SO_3HO = 7 \cdot 25PbS + 2 \cdot 75PbO,SO_3 + 19PbO + 10HO,$$

and this time the sulphide of lead can be secured, as, in spite of its mixture with sulphate, it is sufficiently abundant to be distinguished by its black colour, and its presence can be verified by analysis.

The latter result is furnished by experiment, and it may easily be supposed that the formation of sulphide will continue during the whole of the action of the materials in the retort. In fact, as soon as a certain quantity of acid has been decomposed by the lead, the water abandoned combines with a new equivalent of acid, and when half the acid originally in the retort has been employed, the other half is no longer concentrated acid SO_3HO, but is evidently acid $SO_3 2HO$. Now, for this acid is found the equation—

$$357PbO + 100SO_3HO = 89 \cdot 25PbS + 10 \cdot 75PbO,SO_3 + 257PbO + 200HO.$$

Thus this diluted acid gives proportionally more sulphide.

On taking account of these considerations it becomes evident how easily all the peculiarities occurring during experiments may be represented, and the apparently singular accidents explained. They may not only be explained, but may serve to measure the relation of affinities. Thus the formation of sulphide during the action of sulphuric acid on lead proves that at that temperature and under those conditions the affinity of sulphur overcomes that of oxygen for lead.

At present I give but this one instance; but the explanation is applicable to all similar instances, and will give the clue towards the unravelling a great number of facts as to which we have hitherto been in the dark.—*Les Mondes.*

TECHNICAL CHEMISTRY.

On the Preparation of a Green Colour without Arsenic,

by Dr. Elsner.

Having recently had occasion to study a pulverulent green colouring matter which he had been requested to analyse, and which was called ***green cinnabar***, the author found that this matter, all shades of which could be obtained, from the lightest to the darkest, contained various proportions of prussian blue and chromium green. This colour, applicable to the manufacture of paper-hangings, will not serve for painting walls containing lime, as its action alters the tint of the prussian blue. Neither will it serve for colouring bonbons or for any other culinary purpose, because, though it contains no arsenic, it is not free from hurtful qualities. The following are the directions for obtaining the different shades:—

Make a solution of yellow chromate of potash and another of yellow prussiate of potash, then mix the two. Dissolve separately in water some acetate of lead and iron, and add this solution to the others. By precipitating the first two solutions by the third a green deposit is obtained, the tint depending on the proportions employed. It is scarcely necessary to say that the larger the quantity of acetate of lead and chromate of potash, the lighter the shade obtained.

Wash the precipitate carefully and dry it with gentle heat.

The necessary acetate of iron may be obtained in various ways, especially by precipitating a solution of acetate of lead by sulphate of iron and filtering the supernatant liquid.—*Moniteur Scientifique*, v. 382. 68.

Formation of Chloro-carbonic Acid.—When a perfectly dry mixture of chlorine and carbonic acid is passed through a porcelain tube filled with pieces of charcoal, and heated to redness, chloro-carbonic acid is formed. (Dr. Schiel, *Zeitschr. für Chem. and Pharm. Heft.*, vii, p. 220.)

The Berlin Professorship.—We have the best authority for stating that the chair recently vacated by the demise of the late Professor Heinrich Rose, has been offered to Professor H. Kopp, of Giessen, who has accepted the same, and will before long enter upon the duties of his new appointment.

Restoration of Violet Colour.—A lady correspondent sends us the following process for restoring the violet colour discharged from silk by acid juice:—"Brush the portion of fabric with tincture of iodine, then after a few seconds well saturate the spot with a solution of hyposulphite of soda, and dry gradually. The colour will be perfectly restored."

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.

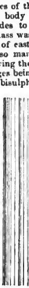
Thursday, April 7, 1864.

Major-General Sabine, *President, in the Chair.*

The first paper was by Dr. Dickinson, "*On the Functions of the Cerebellum,*" communicated by Dr. Bence Jones. The writer glanced over the suppositions that have been made at various times as to the functions of this important division of the brain. It has been imagined to be the seat of memory because of its hardness, and from the fact that one is apt to scratch the back of the head when thinking. Some have supposed it to be a second brain, to be the source of involuntary motions, to regulate the motions of the heart and of respiration, a seat of sensation (from the situation of the origin of the fifth cranial nerve), the centre for movements in general, for the functions of reproduction, for co-ordinating bodily movements, for harmonising movements, &c. The author considered none of these functions strictly appropriate to the cerebellum, and has performed a series of experiments with a view to decide this question. The same great divisions of the nervous system can be traced in all the vertebrate animals in which it attains any development, namely, the cerebrum, the cerebellum, and the medulla oblongata and spinal cord. It may be concluded that the functions of each part are to some extent the same in all animals, and in this case a series of experiments on the effects produced by the removal of the different parts would afford data, even if the lower animals were the patients, from which the functions of the same organs in animals higher in the series might be inferred; these latter not admitting of experiments being performed on them, the results being mixed up with the effects of the injury. The course he followed was to remove both cerebrum and cerebellum, leaving only the medulla oblongata, and to compare the effects with those produced by the removal of the cerebellum alone, and of the cerebrum alone. It would take too much space to give a detailed account of all the experiments performed, but it may be stated that with the lower animals, such as reptiles, the effect of a removal of both cerebrum and cerebellum was to take away all voluntary power in the field snake, which remained motionless; the frog performed regular but tardy movements; the salamander was motionless except when irritated; the toad, although it could not walk or swim, tried to turn when laid on its back; the tortoise performed some apparently voluntary motions when irritated, but all movements ceased in twenty-four hours; the eel wriggled, but there were no voluntary movements. When fishes were the objects of the experiments the removal of both cerebrum and cerebellum took away almost all evidence of life, although in some cases respiration and slight convulsions were observed. On submitting the higher animals to a similar mutilation speedy death interfered with observation of the results. The general effects of removal of the cerebellum alone were to produce a loss of activity and of the power of co-ordinating movements, so as to retain the balance, &c., a greater effect being produced on the hind than the fore quarters. A curious stilted motion was observed when the animals walked. The effects of loss of the cerebrum were a loss of vigour, but the animal appeared capable of performing all motions. There were, however, differences according to the place of the animal in the scale of beings. An experiment on the contractile power of the muscles after injury of the cerebellum was tried on the water tortoise. The effect of an injury on one side only was to cause only a slight loss of contractile power, but the opposite limb was always extended. The general result arrived at was that the cerebellum was not concerned in the production of heat, of the secretions, of the motions of copulation, of general motion, or of general sensation. In snakes it appeared that each of the three divisions of the great nervous centre were concerned in the production of motion; in fishes the medulla alone was not sufficient to produce voluntary movements, and in the absence of the cerebellum there was not a proper adjustment of motion; in fishes and reptiles the cerebrum and cerebellum both shared in producing voluntary motions. The fore parts of animals seemed to be dependent more immediately on the cerebrum, the hinder parts on the cerebellum; the cerebellum seemed to regulate habitual movements, and the cerebrum, impulsive movements proceeding more directly from the will. In cases of human beings with congenital absence of cerebellum, there was a want of power of voluntary movement in the muscles of the lower extremity. It would appear that each lobe is in connexion with all four limbs. The author considered that the cerebellum had nothing to do with general sensation, or with any particular sensation. He advanced an hypothesis that, as the cerebellum consisted of two parts, it had two duties, the outer layer being the seat of voluntary motor power, while the inner was concerned in co-ordinating movements.

Professor Sylvester then read a paper entitled, "*An Inquiry into Newton's Rule for the Discovery of Imaginary Roots, together with an Introduction to the Theory of Algebraical Equations with Conjugate Co-efficients.*" He stated that Newton himself had not furnished us with a demonstration of the rule, nor had he left behind him a record that he had succeeded in accomplishing a demonstration, so that its discovery was still desirable. The author did not profess to have furnished a perfectly general demonstration, but only to have made some steps towards it; equations of the fifth degree, however, presented some difficulty. The Professor entered into various questions connected with these equations, such as the curves that they might represent, &c.; but the subject being of such an abstruse nature, he only glanced cursorily over these points.

A communication from Mr. Gassiot, being a description of a train of eleven bisulphide of carbon prisms arranged for spectrum analysis, was then read. The description of the apparatus was one of the points of interest. In its construction many difficulties had to be overcome, one of which arose from the circumstance that the cement employed to fasten the sides of the prisms to the ground-glass bottles forming their body was apt to cause the glass plates forming the sides to warp. To obviate this, a second piece of crown glass was pressed on the surface of each side, a thin layer of castor oil being interposed to prevent reflection from so many surfaces. A great advantage was gained by having these exterior pieces of glass wedge shaped, the wedges being so placed that they acted antagonistically to the bisulphide prisms, thereby diminishing the refraction without materially altering the dispersion. In this manner eleven prisms could be employed without blending the ray to an inconvenient extent, whereas otherwise only seven could have been used. On examining the double line D after passing through this train, it was found that its two components are separated three minutes and six seconds, and that there was a third line exactly equidistant between them, together with other lines filling up the intermediate space as had been before observed, as shown in the accompanying diagram; but the most re-



markable circumstance was that the two dark lines composing the double line were themselves each split up into three lines, the centre one being the thickest. It is intended to examine other parts of the spectrum with this apparatus.

CHEMICAL SOCIETY.

Thursday, March 17, 1864.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

The Secretary read the minutes of the two preceding meetings (the second being the anniversary on March 30), both of which were confirmed by the Chairman. It was then stated that a resolution of the Council would be proposed at a future meeting, the requisite formal notice of which was now given, to the effect that the following gentlemen be elected Foreign Members of the Society, viz., MM. Dessaignes, Erdmann, and Von Fehling.

The formal admission of Mr. Henry Bassett, Mr. Coleridge Pole, and Mr. C. Greville Williams was declared by the President, after which the members proceeded to ballot for the election of Mr. Wentworth Lascelles Scott, who was unanimously elected a Fellow of the Society.

The Secretary then read a paper "*On Oxyaniline,*" by Dr. Schmidt, student in Professor Kolbe's laboratory. The author commenced his researches with nitro-salicylic acid, which was known to form an amido-acid having the formula—

$$HO(C_{12}\left\{\begin{matrix}H_4\\H_2N\end{matrix}\right\}O_2(C_2O_2)O$$

By submitting this amido-salicylic acid to destructive distillation, it was found to split up into carbonic acid and a white crystalline substance for which the name of oxyaniline was proposed. The acid should be mixed with twice its weight of powdered pumice stone before being heated, and however carefully the process was conducted, a small quantity of a fusible brown product was volatilised along with the oxyaniline. This impurity could be removed by digesting with alcohol mixed with a small proportion of acetic acid, wherein it was freely soluble. The equation explanatory of the formation of oxyaniline was thus represented :—

$$\underset{\text{Amido-salicylic acid.}}{HO(C_{12}\left\{\begin{matrix}H_4\\H_2N\end{matrix}\right\}O_2(C_2O_2)O} = \underset{\text{Oxyaniline.}}{\left.\begin{matrix}C_{12}H_5O_2\\H_2\end{matrix}\right\}N} + C_2O_4$$

The properties of oxyaniline were thus described :—The pure sublimed product took the form of definite white needles, which were soluble in water, forming a solution which soon acquired a brown tinge by spontaneous decomposition. This liquid became coloured of a deep indigo on the addition of alkalies, and was again bleached by the action of acids. The aqueous solution had the power of reducing the compounds of the noble metals, becoming, at the same time, changed to a violet liquid. Oxyaniline unites with hydrochloric, hydrobromic, hydriodic, and other acids, forming salts, which, when perfectly neutral, were liable to spontaneous change, but when containing excess of acid were quite permanent.

The President considered these results especially interesting at a time like the present when aniline and aniline compounds were engaging a large share of scientific attention. With reference to the relation subsisting between salicylic acid and the members of the phenyl group, it was remarkably how widely different were the physical properties of the ordinary hydrated oxide of phenyl from coal tar, and that obtained by the action of heat upon salicylic acid. The two bodies were perfectly isomeric, although they exhibited certain differences in their deportment with pentachloride of phosphorus.

Dr. Frankland believed that the new process of Dr. Schmidt would offer an insight into the molecular constitution of this class of bodies. The author had written the formula of oxyaniline on the ammonia type, but the speaker thought it might, with greater propriety, be regarded in the character of a body framed on the pentatype of nitrogen, and similar to the oxide of ethyl-phosphine, when it would be written thus :—

$$\left.\begin{matrix}C_{12}H_5\\H_2\\O_2\end{matrix}\right\}N.$$

The equivalentic value of carbon used by Professor Kolbe and Dr. Schmidt remaining the old number 6. The speaker also suggested that the determination of the monobasic or bibasic character of the body would afford a further clue of great value.

Mr. Henry Bassett was then invited to read a paper "*On the Sub-formiate of Ethyl, and on the Basic Salts of some Organic Acids.*" The author commenced by referring to a preliminary account of the preparation of the subformiate, which had already appeared in the seventh volume of the Chemical News (page 158), and pointed out the advantage of proceeding in the manner then indicated; for by reversing the steps in that process, viz., by adding ethylate of sodium to the chloroform, a considerable loss of product was occasioned by a secondary reaction, in which a copious evolution of carbonic oxide gas occurred. The partial destruction of the compound under these circumstances was thus represented :—

$$2\left.\begin{matrix}CH'''\\(C_2H_5)_3\end{matrix}\right\}O_3 + \left.\begin{matrix}C_2H_5\\Na\end{matrix}\right\}O = CO + CHNaO_2 + \left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O + 3\left.\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right\}O.$$

It would be observed that this equation accounted for the production of ether and alcohol which had been noticed by Messrs. Williamson and Kay when using dry ethylate of sodium in their experiments of 1854. The mode of preparation recommended by the author was very simple, and usually gave a product nearly equal in bulk to the chloroform used. 18 ounces of absolute alcohol were mixed with 3 ounces of chloroform in a flask provided with a long glass tube to serve as a condenser, 1½ ounce of sodium, cut into small pieces, were then gradually added, its action being assisted by a gentle heat in the water bath. The alcohol was then distilled off and the residue dissolved in water, when the supernatant oil, dried over chloride of calcium and rectified, answered perfectly to the pure tribasic formiate of ethyl— $\left.\begin{matrix}CH'''\\(C_2H_5)_2\end{matrix}\right\}O_2.$

The author then proceeded to describe the preparation of the tetrabasic carbonate of ethyl, viz., by gradually adding the proper quantity of sodium to a mixture of chloropicrin and absolute alcohol, the mixture being heated in a water bath, then distilling off the alcohol, and dissolving the residue in water, when the substance in question floated upon the surface of the aqueous solution. The reaction was as follows :—

$$CNO_2Cl_3 + 4\left.\begin{matrix}C_2H_5\\Na\end{matrix}\right\}O = 3NaCl + NaNO_3 + \left.\begin{matrix}C''''\\(C_2H_5)_4\end{matrix}\right\}O_4$$

The pure substance boils at 158°-159° C., and has a specific gravity ·925. Two analyses gave results closely agreeing with the theoretical composition, as also did a determination of the vapour density. When boiled with alcoholic potash, the substance deposited a considerable quantity of the alkaline carbonate.

Some of the substance was digested for six hours in the water bath with boric anhydride, and the result distilled; the distillate after purification consisted entirely of ordinary carbonic ether, as was shown by an analysis. The boiling point also was 125°C. This decomposition was thus explained :—

$$\left.\begin{matrix}C''''\\(C_2H_5)_4\end{matrix}\right\}O_4 + 2B_2O_3 = (C_2H_5)_2B_4O_7 + (C_2H_5)_2CO_3$$

The author had attempted to produce homologous bodies by the action respectively of the chloride of acetyl (othyl) and the tetrachloride of carbon upon ethylated sodium; but no such substances could be formed. The reaction in the latter case especially was very feeble. Reference was then made to the fact that the addition of water to glacial acetic acid raised the specific gravity. The composition of this acid at its greatest density being $C_2H_4O_2 + H_2O$, seemed to show a tendency to form a triatomic hydrate, which could then be written

$$\left.\begin{array}{c}C_2H_3{}'''\\H_3\end{array}\right\}O_4$$

The interesting relations existing between the ordinary and the tribasic formic ether and the glycidic ethers and the glycerides were then shown as under:—

$$\left.\begin{array}{c}CH'''\\C_2H_5\end{array}\right\}O_2 \qquad \left.\begin{array}{c}CH'''\\(C_2H_5)_3\end{array}\right\}O_3$$

Formic ether. Tribasic formic ether.

$$\left.\begin{array}{c}C_3H_5{}'''\\C_2H_5\end{array}\right\}O_2 \qquad \left.\begin{array}{c}C_3H_5{}'''\\(C_2H_5)_3\end{array}\right\}O_3$$

Glycidic ether. Tri-ethylane.

Thus indicating the probable existence of two distinct series of isomeric bodies—one derived from the fatty acids and the other from the triatomic alcohols. The author suggested the possibility of producing the glycidic ethers directly from the glycerides by the action of boric anhydride, and concluded with some general remarks upon the basic salts of certain organic acids.

The **President** believed he was correct in affirming that there was a discrepancy between the experiences of Mr. Bassett and of Mr. Lockwood, who formerly worked in his own laboratory at University College. Some time had elapsed since the last-named gentleman made the observation that tetrachloride of carbon, as prepared by passing a mixture of chlorine and chloroform vapour through a heated tube, acted very powerfully upon the ethylates of potassium and sodium, and gave rise to a violent evolution of mixed gases, particularly carbonic anhydride and olefiant gas, with a large quantity of ether vapour, were given off, whilst an alkaline chloride was formed. If his memory had not deceived him, the statement of these independent results showed a divergence which was worthy of further investigation. If these observations could be repeated under circumstances so modified that the action should not, on the one hand, be so violent as Mr. Lockwood had represented, nor so feeble or indifferent as Mr. Bassett had just now described, there was a probability of some useful results being obtained.

Mr. **Bassett** explained that the method which he had followed in the preparation of tetrachloride of carbon was that of exposing chloroform to sunlight for several days in an atmosphere of chlorine gas. The product so obtained had certainly no energetic action upon the alcoholic solution of ethylate of sodium; there was no gas given off, and the only product yielded, whether in sealed tubes or at the boiling point of alcohol, was a brown substance, which resisted the solvent action of all the liquids he had tried, and appeared altogether unpromising in character.

At the conclusion of the ordinary business of the meeting, Mr. **Septimus Piesse** rose to call the attention of the Society to an announcement which appeared in the *Times* and other newspapers of that day to the effect that a sum of money, amounting to upwards of 1000*l.*, had already been subscribed for the purpose of erecting and endowing almshouses in Penzance as a lasting memorial to the great English chemist Sir Humphry Davy. Whether this or other form of recognition,—a statue, for instance,—be ultimately determined upon, the speaker considered it desirable that the Society should take united action in giving support to the movement, and in endeavouring to secure the erection of a worthy monument to so eminent a man.

The **President** thanked Mr. Piesse for calling the attention of the Society to the subject, and requested him to prepare a formal resolution upon which the Council might take action.

The meeting was then adjourned until the 21st Inst., when Mr. J. T. Way will deliver a discourse "*On the Philosophy of British Agriculture.*"

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture IX.—*Thursday, January 21, 1864.*

Ladies and Gentlemen,—We now proceed to the consideration of sea water.

The subject of sea water is, indeed, a grand one. We are indebted to Forchammer for some of the best researches —about the most recent as well as the most elaborate. I propose, in the first place, to examine carefully all the elements which have been clearly detected in sea water. No doubt there are many which have eluded our means of analysis. We cannot go beyond a certain point. We have received great aid of late from spectrum analysis, by means of which we are enabled to determine the presence of certain elements by the agency of light. Our senses may afford us evidence of the existence of certain substances, although we may be unable to find them out by our ordinary processes of analysis. Let us take the familiar examples of odours. A small grain of musk may scent a large room, and we know perfectly well that the musk must be there; but although we are sure of its presence, we should be unable to detect the musk by chemical analysis, and thus the power of scent may go far beyond the powers of the greatest chemist in the world.

Twenty-seven distinct elements have been found in sea water.

First of all, there is the water itself. That is composed of oxygen and hydrogen in the proportion of eight parts, by weight, of oxygen to one of hydrogen. Then there is the oxygen dissolved in the water. All water contains oxygen or air dissolved, and the oxygen is dissolved in a greater proportion than the nitrogen of the air. It is this oxygen which is essential to the existence of animal life in the ocean, or in waters generally. Ocean water contains a little organic matter, and of that oxygen is a constituent. We have, then, oxygen as an essential constituent of the water, oxygen dissolved in the water, oxygen as a constituent of the organic matter in the water, and, again, as a constituent of the bases, and of certain acids existing in sea water.

Hydrogen forms one-ninth of the water. It also is a constituent of the organic matter found in the water.

Chlorine forms the largest proportion of the solid ingredients of sea water, existing in combination with various metallic bases, such as calcium, magnesium, and sodium.

Next in order comes bromine, which is also present in sea water, and is, in fact, extracted from sea water. It is obtained from the mother liquor, resulting from the evaporation of sea water and the crystallisation of its salts.

Then comes iodine, which is extracted from sea water, and which can only be derived from sea water. Some years ago elaborate researches were made with regard to the association of the three elements—chlorine, bromine, and iodine—with each other, especially by a chemist of Turin. It was found that they were always in association. Wherever chlorine was, there were traces of bromine and of iodine.

There are two ways in which we can prove the existence of elements in sea water,—first, directly in the water itself by the aid of chemical analysis; and secondly in the plant and animal structures existing in the water, and which can certainly derive their materials only from the water. The one kind of evidence is, I think you will admit, as conclusive as the other. Fluorine is found in the roots of corals. When these are dissolved by hydrochloric acid and precipitated by ammonia, the deposit contains fluoride of calcium—fluor spar, in fact. Forchammer obtained fluorine by the direct evaporation of 100 lbs. of sea water from the Sound of Copenhagen until the common salt obtained began to crystallise. He then added ammonia, digested the precipitate with sal ammoniac, collected the residue, and ignited it. It consisted of phosphate of lime—that is, apatite and fluoride of calcium. You will see one or two curious points in connexion with this presently. It weighed from the 100 lbs. of water as much as 3·1 grains, which is a large amount for the chemist. He easily found fluor spar in the deposit of the boilers of Atlantic steam ships. There is, then, no doubt whatever of the presence of fluorine in sea water.

Sulphur exists in combination with oxygen, forming sulphuric acid. This sulphuric acid is combined with the bases in the water. Sea water, when free from organic matter, may be kept undecomposed in bottles for many years, but when it contains the remains of microscopic animals it undergoes decomposition, and sulphuretted hydrogen is evolved. The sulphuric acid of the salts gets reduced by the presence of organic matter. The largest quantity of sulphuretted hydrogen was found in the water, near the mouth of the river La Plata. The average relation between the chlorine of sea water and the sulphuric acid is as 100 to 11·89. It is very interesting to study the constitution of sea water in this way. I have taken chlorine, the most abundant constituent, as the standard of comparison, and represent it by 100.

Phosphorus is always present, and exists in the state of phosphoric acid. In the evaporated residue washed with water, phosphate of lime is found along with carbonate of lime, fluoride of calcium, sulphate of baryta, sulphate of strontia—that is an interesting point—and silica. There is good reason to believe that there are also borates of lime and magnesia. We shall see the evidence of this directly.

Carbon exists in sea water as free carbonic acid, and as a constituent of the organic matter which may be present, and in very small quantity as combined with lime. Forchammer tells us that all sea water reduces hypermanganate of potash, and therefore contains organic matter, the reduction being effected by means of such matter.

Nitrogen is present dissolved in the sea water, and as a constituent of organic matter. So far as I know, it has not yet been found to exist there in the state of ammonia.

Silicon is present as silica. It exists in the washed residue after evaporation. If you evaporate sea water to dryness, wash it with water, and then treat it with hydrochloric acid, you get a residue containing silica. Moreover, it is found in shells and in corals. A large quantity is met with also in certain sponges, and to such an extent in some sponges from the East Indian seas that after the organic matter is burnt off, the form of the sponge is left in a coherent state. This is due chiefly to the presence of silica. You get, in fact, after the burning, a sponge consisting of silica almost entirely, or to a very large extent.

Next comes boron. This element is present in the form of boracic acid combined with bases. Forchammer sought long in vain to find boron directly in sea-water, while there was certain proof of its being there. It has been found as boracic acid in certain deposits which are found in Prussia, and which have clearly resulted from the evaporation of sea-water.

(To be continued.)

PHARMACEUTICAL SOCIETY.

Wednesday, April 6.

Mr. Sandford, *President, in the Chair.*

The subject of percolation may be said to be as completely exhausted as any substance that was ever submitted to the process, and might now be displaced by another topic of more novelty, if not of greater interest. It was, however, again introduced by Professor Redwood, who, in a paper "*On Percolation,*" once more went over the history and *rationale* of the process, the arguments for and against its application to the making of tinctures, and the advantages and disadvantages of certain forms of percolators. With all this we may assume that our pharmaceutical readers are well acquainted, but we may give a brief summary of the paper. Introduced into pharmacy between thirty and sixty years ago, the use of percolation has gradually extended, but in no country and at no time has it completely superseded the older and simpler plan of making tinctures by maceration. There is no difference of opinion about the use of it as a means of effecting the complete exhaustion of a material, and it is specially applicable for making concentrated tinctures, like essence of ginger. But no fixed rules can be laid down so as to enable an inexperienced operator to conduct the process successfully, and it becomes dangerous in the hands of a careless or unskilled person. In general, materials to be operated upon require to be in as fine a state of division as is compatible with uninterrupted percolation. It must be remembered that it is not sufficient for the liquid to pass over the surface of the particles of the material. It must permeate their substance by capillary attraction and circulate through the mass, so that the successive particles of liquid may come in contact with the molecules of solid matter, until all the soluble portion has been imparted. In this it differs from maceration, in which process the material may be said to act like a sponge in absorbing the menstruum where it remains quiescent, while in percolation there is a constant change of particles caused by the hydrostatic pressure of the column of liquid. The advantage of the process of percolation is, that by its means the whole of the dissolved portion is recovered, while after maceration a considerable quantity will remain in the mass, even after it has been submitted to great pressure. There are differences of opinion about the best form for a percolator. A few persons prefer a cylindrical, but the general opinion is in favour of the conical form. The objections to a cylindrical percolator are, first, that when the material becomes saturated with the menstruum it is apt to swell and impede percolation; second, that a substance, like opium, containing much soluble matter, becomes reduced in bulk, and, shrinking away from the sides, leaves a channel for the menstruum to pass without permeating the material; and third, that from the disposition of a liquid passing down a cylinder to aggregate towards the centre, there is always left near the bottom a portion of material through which the percolation has been imperfect. All these objections are obviated by the use of a conical percolator. In the first case, when the mass swells it only rises and accommodates itself to the shape of the vessel; in the second, when it contracts it only settles down, and still remains adherent to the sides; and the third objection is of necessity obviated by the shape of the vessel. In the course of his remarks, Dr. Redwood strongly condemned the practice of displacing, or endeavouring to displace, the last portions of spirit by means of water, and showed that, while it was possible to displace water by means of spirit, water added to a spirituous mixture immediately mixed with it. The practice, he said, only resulted in the deterioration of the tincture. Dr. Redwood came lastly to a form of apparatus he has devised for making tinctures by a process which he believes to be an improvement of that of the British Pharmacopœia. This apparatus consists of a cylindrical vessel with a rounded bottom, and furnished with a tap. It holds three-fourths of the menstruum, as directed in the Pharmacopœia, in which the materials to be macerated can be suspended in a flannel bag. This is so far a modification of Dr. Burton's displacement apparatus, and our readers will see that no necessity for agitating the materials exists. When the period for macerating has expired, the fluid may be drawn off, and then a metal cylinder passed down within the flannel bag, so as to enclose the materials, forms a percolator with a flannel bottom through which the remaining fourth of the spirit may be passed. To carry out the last part of the process, it is only necessary to withdraw the metal cylinder from the bag, which can then be placed under the press, and so the whole of the process carried out with the utmost ease.

Mr. Deane, who has given great attention to the process of percolation, then made some remarks, in which he stated that, from his experience, the process was not one which could be safely left to any one to carry out. It required special skill and attention to many particulars. He then alluded to his first experiments with a cylindrical percolator, and the discovery which led him to adopt the conical form, namely, the fact that at the bottom of the cylinder there was always left an angular space through which the menstruum did not pass. Mr. Deane then dwelt on the necessity of a tap or some other contrivance for regulating the flow of the liquid—a point which requires special attention. He recommended that, before packing the materials, they should be wetted with half their weight of the menstruum, so as to drive out the air from the intercellular spaces, and so avoid the formation of channels through the mass in the percolator. In general, he said, it would be that a quantity of menstruum four times the weight of the materials would be sufficient to exhaust them. In some cases five or six times the weight might be required, but in no case less than three times, and therefore the quantity of spirit ordered in the Linamentum Belladonnæ, P.B., was not sufficient.

Mr. Hills, in a few words, expressed a strong opinion in favour of maceration as a method of making tinctures.

The meeting then adjourned.

We may here supply an omission from the report of the previous Pharmaceutical meeting, at which Mr. Haselden read a paper on "*Percolation*," and exhibited a new form of percolator intended to carry out the instructions of the British Pharmacopœia. The percolator is made of block-tin, and is furnished with a tap at the bottom, by which the operator is able to macerate as long as required before the fluid is allowed to pass through; it is cylindrical, and furnished with a moveable perforated diaphragm, about two inches from the bottom, resting upon four supports; the ingredients are placed upon this diaphragm, and three-fourths of the spirit poured on as directed; a portion passes through and fills up the space between the bottom of the percolator and the diaphragm, so that the material while macerating is surrounded by the liquid; it can be well stirred during this primary part of the process. At the expiration of forty-eight hours the tap is turned, and the tincture or liquor allowed to pass through into a glass receiver, of almost any size, fitting the tap by means of a shive; that completed, the second perforated diaphragm is placed upon the top of the material, and the remainder of the liquid added. This having ceased to percolate through, the marc, as directed, is taken out, pressed, and the liquor mixed with the other portion, and the quantity of spirit added to make up the full measure of one or two gallons, as the case may be. The quantity of proof spirit lost in making two gallons of compound tincture of cardamoms was only eight ounces, and the colour and taste of the product were excellent.

Two supplementary meetings are announced for the discussion of the Pharmacopœia.

ACADEMY OF SCIENCES.

April 4.

A memoir "*On the Alcoholic Fermentation*," by M. Béchamp, was read. The author remarks that two orders of ferments exist—one soluble, and therefore not organised, of which diastase may be taken as the type, the other organised, and therefore insoluble. The action of the former is invariable and specific; that of the latter, in a chemical point of view, is essentially variable, like that of all organised beings. The so-called fermentation of cane sugar set up by beer yeast is thus explained:—The yeast plant first of all transforms cane sugar into glucose outside itself by means of a product which it contains ready formed in its organism, and which the author calls *zymase;* the plant then absorbs the glucose, digests and assimilates it, grows and multiplies, and finally throws off the used parts of its tissues in the form of the numerous compounds known as the products of fermentation, just as human beings throw out their waste in the form of urea, &c. According to this theory the alcohol, &c., must come from the yeast, and should be obtained from yeast perfectly free from glucose, which the author's experiments prove does in fact furnish alcohol. M. Béchamp found also that the *Mycoderma Aceti* in contact with cane-sugar yielded alcohol, which it is thus seen may be formed without sugar by yeast, and with sugar by another organism similar to yeast. Hence it is clearly impossible at present to express the so-called fermentation changes by an equation. The author considers them as a series of transformations which take place simultaneously or consecutively, and which may some day be individually explained by an equation comparable to that which expresses the change in starch under the influence of diastase.

In a paper "*On the Estimation of Gases in Soft Waters*," M. Robinet makes known the fact that petroleum, oil of lavender, oil of turpentine and benzine are capable of absorbing and holding in solution considerable quantities of air. When boiled in a proper apparatus they did, in fact, disengage the following proportions:—

Petroleum (by volume)	6·8	per cent.
Oil of lavender	6·89	,,
Benzine	14·00	,,
Turpentine	24·18	,,

On exposure to air afterwards, they again absorbed the same proportions. Petroleum and, probably, the analogous oils also dissolve carbonic acid. M. Buignet has determined the elastic force of the vapour of a specimen of petroleum, which he finds to be less than that of water. M. Jodin communicated some "*Researches on the Modifications produced by Inactive Substances on the Rotatory Powers of Sugars*," which seem, indeed, to be considerably modified in some instances by alcohol, and in all by lime. M. Marcé sent an account of some experiments, which prove that *oil of wormwood*, in doses of from 3 to 8 grammes, produces poisonous, but not fatal, effects. Trembling, stupor, and insensibility are produced with epileptic convulsions and stertorous breathing. The experiments throw some light on the nervous symptoms which follow the excessive use of *absinthe*. M. Barral sends to the Academy a note on a *curious form of hailstone* he observed in Paris on the afternoon of Easter Tuesday. The stones were of an absolutely conical form. We were passing through St. Paul's-churchyard about four o'clock on the same afternoon, and observed precisely the same phenomenon. We picked up at least a dozen of perfect cones, some of them three-quarters of an inch high and half an inch broad at the base. This form of hailstone, M. Barral says, has never before been noticed by meteorologists. Among the cones we noticed a few pyramidal stones which have been observed before. M. Barral observed traces of crystallisation in the structure of the stones he saw, and says they were very hard. Those we picked up were quite soft, and looked like moulded snow, and we remarked no trace of crystallisation. How were the cones produced?

MM. Davanne and Girard communicated a note "*On some Theoretical and Practical Researches on the Formation of Positive Photographic Prints*." We shall give in this place only the authors' explanation of what takes place in the case of albumenised paper on exposure to sun-light and afterwards in the fixing bath. In the first place they believe in the formation of an insoluble argento-organic lake which gives the characteristic red tone. The change of colour which takes place on immersing the print in the fixing bath they say is the consequence of the hydration of the argento-organic compound, and the same change is produced on exposing the proof to steam. Chloride of silver they believe to be completely reduced in the exposure, the chlorine set free combining with the silver of the free nitrate, and so forming successive layers of chloride, the decomposition of which gives the depth to the print. In this way the authors explain the difference between the pictures produced by chloride of silver alone and those in which an excess of nitrate of silver is employed. Some of these views are original, and we shall give the paper at greater length in our photographic department.

M. Hugo Schiff announces the discovery of another "*New Series of Organic Bases.*" They are, in fact, diamides formed by the action of aldehydes on aniline. The author has studied the action of various aldehydes on aniline, and has come to the conclusion that this body will serve to distinguish a true aldehyde in doubtful cases; thus he decides that oil of rue is not an aldehyde, because it does not act on aniline.

M. Chautard has discovered the presence of caproic and several other acids of the series $CnHnO_4$ in the flowers of *Satyrium hircinum*. The acids can be obtained by the simple distillation of the flowers with water. Butyric and valeric acids are present, but caproic predominates.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

March 22, 1864.

E. W. Binney, *Esq., F.R.S., &c., President, in the Chair.*

Professor Roscoe read the following extract from a letter which he had received from Professor Böettger, of Frankfort, respecting the occurrence of the salts of cæsium, rubidium, and thallium together, in the salt obtained by evaporating the mineral water of Nauheim, near Frankfort:—

"The Nauheim salt is a highly valuable substance, as being perhaps the only material from which cæsium can be obtained in quantity. According to my experiments, 1 cwt. of this salt yields 1 lb. of double chloride of cæsium and platinum, containing small quantities of the rubidium and thallium double salt. At my special request the "Kurfürstliche Salzamt" in Nauheim has arranged to sell this evaporated salt, packing included, at the exceedingly low rate of one thaler (3s.) per cwt. In my spectrum investigations I almost invariably employ a flame of hydrogen in place of the common Bunsen's lamp, as by this means I obtain a higher temperature, and the lines appear, therefore, more distinct. The spectrum of the triple platinum-chloride of cæsium, rubidium, and thallium thus obtained exhibits, in the first place, the well-defined emerald green line of thallium, soon afterwards the two brilliant blue cæsium lines appear close together, then the very broad and ill-defined blue bands of rubidium are seen, as well as the two narrow red lines characteristic of this metal.

"I have lately discovered the presence of thallium not only in many other mineral waters, but also in the vegetable kingdom, in very minute, although perceptible quantities. Thus thallium occurs in the ash or the charcoal from wine yeast, in molasses, tobacco, chicory root, &c. If four pounds of any of these substances are taken, a quantity of the double chloride of platinum and thallium is obtained sufficient for many experiments. According to my most recent experiments, thallium occurs in the dust from the pyrites burners as thallium-iron-alum. I have lately prepared this salt directly from the sulphates of thallium and iron; it is the most easily soluble of all the thallium salts; it possesses the pale reddish amethystine colour of ammonia-iron-alum, it crystallises like this salt in large regular octohedra, and contains twenty-four atoms of water. Sulphate of thallium is isomorphous with sulphate of potassium, and the fact of the formation of the above double salt is another proof of the close relationship between thallium and the alkaline metals, independently of the fact that it almost invariably accompanies potassium, and not unfrequently both cæsium and rubidium."

NOTICES OF BOOKS.

Notes on the British Pharmacopœia, &c. By A. F. Haselden, Pharmaceutical Chemist. London: Hardwicke. 1864.

There are many persons who, like the learned President of the College of Physicians, although they may not so indiscreetly confess it, have not been able to make themselves acquainted with all the details of the British Pharmacopœia. To such this little book may be of some use. Tables of the changes and omissions from the last pharmacopœias of the London, Edinburgh, and Dublin colleges are given, and also of the additions made. The author then goes through the preparations and compounds of the Pharmacopœia, giving usually a paraphrase of the directions with some original comments, and whenever necessary calling particular attention to alterations of strength. An extract or two will give our readers the best idea of the contents of the book:—

"*Infusum Sennæ.*—The alteration in this infusion is very important, more especially in respect to the infusions of London and Edinburgh: it contains only half the quantity of senna, and ten grains less ginger than London; it has one-third less senna, and ten grains less ginger than Edinburgh: the proportions are those of Dublin; so that one ounce of this aperient infusion is equal only to half an ounce of London, and two-thirds of an ounce of Edinburgh."

"*Linimentum Cantharidis.*—This is new to the Pharmacopœia. Four ounces of powdered cantharides are to be macerated with two fluid ounces of acetic acid for twenty-four hours, then placed in a percolator, and ether allowed to pass slowly through until ten fluid ounces are obtained. The loss of ether in making small quantities is about one-third. This preparation will produce a perfect blister, and, therefore, must not be used as a liniment, or confused with the Dublin liniment composed of cantharides and olive oil. Liniment of Cantharides does not seem to be the right name."

Journal für Praktische Chemie. No. 6, 1864.

This number of the Journal contains short articles giving the latest experiments of Deville and Troost "*On Vapour Densities at very High Temperatures,*" "*On Anomalous Vapour Densities,*" and "*On the Measurement of High Temperatures.*" The next article contains a hint for the manure manufacturers. A prince who has done some service to science, him of Salm-Horstmar, tried last summer to solve the question, "What is the inorganic material specifically necessary to the formation of the grain in wheat?" Nature, in the prince's experiments, answered lepidolite! The author sowed his seed in a very unpromising soil—namely, roughly-powdered rock crystal which had been carefully purified; and manured the plants with a mixture of the earthy and saline substances usually found in wheat, but only obtained well-formed plants and perfect grains when lepidolite was employed. A paper "*On the Volumetric Estimation of Tannic and Gallic Acids, as well as Iron, Manganese, Indigo, &c.,*" by Moritz Mittenzwey, explains a very simple process and form of apparatus for estimating the above-named substances by observing the amount of oxygen they absorb from the air. We shall give the paper with cuts of the apparatus. Another series of short articles follows, giving the researches of Pasteur and others "*On Putrefaction,*" and on "*American Petroleum.* W. Stein describes a new substance which he has found in the lichen *Parmelia Parietina*, and which he has named *Chrysopicrin*. The formula of this body is $C_{30}H_{11}O_{8}$, the same as that of chrysophanic acid minus an atom of water. Dr. Braun makes a preliminary communication "*On a New Cobalt Compound,*" formed by the action of nitrite of potassium on the cobaltocyanide of potassium. The solution of this substance is of an orange-red colour, and possesses an extraordinary colouring power. Winckler has made some experiments with Thompson's process for the separation of cobalt and nickel by boiling a neutral solution of the two metals in hydrochloric acid and chlorides of calcium and ammonium with carbonate of ammonia, whereby the cobalt is precipitated while the nickel remains in solution. The author found the results, though not exact, sufficiently near for practical purposes. Dr. Mulder describes the spectra of phosphorus, sulphur, and selenium; and Professor Kenngott details several analyses of lithionite. Among the Notizen are the results of some experiments made on a dog with sulphate of soda by Professor Seegen, which will have considerable interest to physiological chemists and physicians. The general result of these experiments leads to the conclusion that the administration of sulphate of soda diminishes the elimination of nitrogenised matters from the system. These results agree with those obtained by the author in his experiments with Carlsbad water on human beings. A notice is also given of Professsor Böttger's process for separating cæsium, rubidium, and thallium from Nanheim water. The process is very simple. The raw salt obtained on evaporation is treated with an equal weight of water. After standing some time, the mixture is thrown on a filter. The clear filtrate contains all the above metals; and the residue on the filter may be thrown away. The filtrate is evaporated to about a third, and then set aside for a night in the coolest possible place to crystallise. All the thallium will be found in the crystalline mass obtained, and the mother-liquor will contain the chlorides of rubidium and cæsium. These may be separated by means of chloride of platinum.

A Dictionary of Chemistry, &c. By Henry Watts, B.A., &c., &c. Parts XIII. and XIV. London: Longman and Co. 1864.

The publication of this valuable work proceeds with the greatest regularity, and the quality of the matter is fully maintained. The article on Heat in Part XIV. is another of those elaborate papers which have given an encyclopædic character to the work.

The Ophthalmic Review: a Quarterly Journal of Ophthalmic Surgery and Science. Edited by J. Zachariah Laurence and J. Windsor. No. 1. London: Hardwicke. April, 1864.

It is gratifying to notice the increase of periodicals devoted to the *science* of medicine and surgery. We should be glad to see more. The *Ophthalmic Review* has been really called for by the immense progress made in ophthalmology—now almost a science in itself—and we wish the Journal every success.

Royal Institution.—Tuesday, April 19, at three, Professor Helmholtz, "On Conservation of Energy." Thursday, April 21, at three, Professor Helmholtz, "On Conservation of Energy." Friday, April 22, at eight, Professor Blackie, "On Lycurgus." Saturday, April 23, at three, Professor Frankland, "On the Metallic Elements."

NOTICES OF PATENTS.

2892. *An Improved Process of Engraving.* P. E. Placet, Paris. Dated October 27, 1862.

For the production of engraved plates for copper-plate printing, the patentee proceeds as follows:—A clean glass plate is first coated with a tolerably thick layer of bitumen of Judea, which then receives its photographic impression by exposure to sunlight in juxtaposition with and beneath any suitable negative or design having parts of unequal degrees of transparency. This operation may be conveniently carried out in the ordinary pressure frame employed in the photographic printing processes. The original negative picture being then removed, the bituminous coating on the glass plate is covered with a film of gelatine applied warm and allowed to set; in this state the whole is plunged into a mixture of naphtha and benzol—(many samples of rectified coal naphtha will be found to answer this purpose)—until the compound layer becomes softened, and ultimately detached from the glass plate. Upon examination it will be found that the portions most acted upon by the light, being insoluble, remain firmly attached to the gelatine, whilst the unaffected parts are entirely dissolved, and the intermediate tints are properly represented by gradations. Carefully removing this layer from the hydro-carbon solvents, by the help of a plate of glass, it will, on examination, prove to consist of an embossed surface, those portions showing the boldest relief which have been most deeply penetrated by the rays of light. In order now to obtain the plate engraved in intaglio, a plaster cast is first taken, and these are again copied and multiplied by the electrotype process.

This invention is undoubtedly based upon the prior labours of M. Niepce de St. Victor, who described, more than twenty years ago, the fact of bitumen of Judea becoming hard and insoluble by the action of light. The copper plate was itself coated with the bitumen, and oil of lavender employed as a solvent for the removal of the unaffected portions. The metallic surfaces thus laid bare were then etched by dilute nitric acid.

2904. *Compound or Material for Coating or Covering Metallic and Vegetable Substances to Preserve them from Corrosion or Decay.* C. S. Duncan, Inverness Road, Bayswater. Dated October 28, 1862.

The inventor proposes to incorporate powdered flint, chalk, sulphur, or glass, with four or five times its weight of marine glue, gutta percha, or caoutchouc, for the purpose of manufacturing plastic compounds very suitable for coating the surfaces of wood and metals. It is recommended to apply them warm, and whilst yet soft, to rub over them any one of a great number of pigments or dry mineral powders which are enumerated in the specification, and finally to polish these surfaces, when thoroughly cold and hard, by friction with any suitable polishing material.

The use of flint powder and resins for coating submarine electric cables, and for insulating purposes, has been highly recommended. The quality of the compositions described by the patentee may be varied *ad infinitum* according to the nature of the application; thus, sulphur would not be an appropriate constituent of a compound intended to be used in the protection of metallic surfaces, although it might answer well upon wood.

2906. *Preparing Albumenised Paper for Photographic Purposes.* Thomas Sutton, Jersey. Dated October 28, 1862.

The inventor soaks the paper in a solution of gutta-percha or india-rubber in benzole or other volatile solvent, dries it, and then proceeds to salt and albumenise the same in the usual manner. The proportion of five grains of caoutchouc to one fluid ounce of benzole is recommended.

The advantages claimed by the patentee are closeness of texture, which tends to keep the albumen more upon the surface of the paper, and thus produces finer photographic impressions. It is necessary, of course, to guard against the dingy colour liable to result from the use of inferior samples of gutta-percha or india-rubber, and to be very particular in keeping the sheets well protected from dust, &c., before albumenising, as the surface at this stage very readily attracts these contaminations. The question of permanence is important, and time only will show whether this kind of paper is subject to the formation of a bloom, or to any of those physical changes which are commonly noticed in gutta-percha.

Grants of Provisional Protection for Six Months.

472. Jean François Rivier, Boulevart de Strasbourg, Paris, "An improved system for filtering and purifying liquids with an endless spouting capillary filter."

474. Henry Carter, Camberwell New-road, Surrey, "Improvements in the manufacture of green colouring matters to be used in dying and printing."

476. George Parry, Ebbw Vale Ironworks, Monmouth, "Improvements in the treatment of slag or the cinder of blast furnaces, for the purpose of utilising the same."—Petitions recorded February 25, 1864.

482. Alexander Prince, Trafalgar Square, Charing Cross, London, "Improvements in filtering apparatus."—A communication from François Michel and Almé Pruvot, Paris.

485. Henri Adrien Bonneville, Porchester Terrace, Bayswater, London, "Improvements in the manufacture of artificial marble."—A communication from Joseph Alibert, Marseilles, France.—Petitions recorded February 26, 1864.

490. Frederick Ransome, Ipswich, Suffolk, "Improvements in the manufacture of artificial stone."

496. James Preston Worrall, Ordsall, Lancashire, "An improved method of colouring or staining the cotton or back of "union silk-faced velvets," or other mixed, cut pile, looped, or "raised" fabrics.

498. John Henry Pepper, Boundary-road, St. John's Wood, London, "Improvements in arranging apparatus for representing spectral and other images on the stage."

500. William Edward Gedge, Wellington Street, Strand, London, "A hygienic and inodorous apparatus, applicable to the cradles or cots of children, and to the beds of adult invalids."—A communication from Paul Geofroy-Gomez, Passage des Petites Ecuries, Paris.

505. Samuel Cooper, Openshaw, and John Mayo Worrall, Ordsall, Lancashire, "Certain improvements in the method of dyeing or colouring certain descriptions of woven fabrics."

521. John Peter, Raeburn, Charlesfield, Mid Lothian, N. B., "Improvements in the production of oil or oleaginous or spirituous and gaseous matters, from coal and other mineral substances and vegetable deposits, and in the machinery, apparatus, or means employed therein."

549. Richard Archibald Brooman, Fleet Street, London, "Improvements in manufacturing a green colouring matter."—A communication from Otto Bredt, Barmen, Rhenish Prussia.

583. John Mayo Worrall, Ordsall, Lancashire, "An improvement in the method of dyeing or colouring looped, cut pile, or raised fabrics composed of cotton and silk."

597. John Thomas Way, Leadenhall Street, London, "Improvements in the manufacture of manure from woollen rags, mixed woollen and cotton rags, shoddy, or waste wool."

Notices to Proceed.

2812. Andrew Craig, Rock Ferry, Birkenhead, "Improvements in distilling hydrocarbons, from coal, shale, and other bituminous substances, and in apparatus employed for that purpose."

2852. William Edward Newton, Chancery Lane, London, "Improvements in the treatment or manufacture of wrought and cast iron and steel."—A communication from Marc Antoine Auguste Gaudin, Rue St. Sebastien, Paris.

2886. William Mattieu Williams, Oak Alyn, near Wrexham, Denbigh, "Improvements in apparatus for the distillation of coal and peat, and such other substances as are or may be used for the manufacture of solid and liquid volatile hydrocarbons, or for the manufacture of the said hydrocarbons and coke.

2894. Heinrich Hirzel, Terminus Hotel, London Bridge, Southwark, Surrey, "Improvements in the manufacture of colouring matters suitable for dyeing and printing."—Petitions recorded November 18, 1863.

2947. Thomas Carr, New Ferry, near Birkenhead, Cheshire, "Improvements in machinery for amalgamating or intermixing dry semi-fluids or aqueous materials, and for agitating solids with liquids for combining, dissolving, or washing the same."—Petitions recorded November 23, 1863.

3290. Henry Caunter, Stornoway, Ross, "Improvements in the manufacture of lubricating matter or composition."—Petitions recorded December 29, 1863.

167. Robert Irvine, Magdalen Chemical Works, Musselburg, Thomas Richardson, Newcastle-upon-Tyne, and John James Lundy, Leith, Mid Lothian, N. B., "Improvements in the extraction or manufacture of oils from animal substances."—Petition recorded January 21, 1864.

496. James Preston Worrall, Ordsall, Lancashire, "An improved method of colouring or staining the cotton, or back of "union silk-faced velvets, or other mixed cut pile, looped, or raised fabrics."—Petitions recorded February 29, 1864.

505. Samuel Cooper, Openshaw, and John Mayo Worrall, Ordsall, Lancashire, "Certain improvements in the method of dyeing or colouring certain descriptions of woven fabrics."—Petition recorded March 1, 1864.

583. John Mayo Worrall, Ordsall, Lancashire, "An improvement in the method of dyeing or colouring looped, cut pile, or raised fabrics composed of cotton and silk."—Petition recorded March 9, 1864.

CORRESPONDENCE.

Continental Science.

Paris, April 12, 1864.

M. Le Verrier has given a lecture at the scientific *soirée* of the Sorbonne, which passed off with great *éclat*; but it is remarked that the audience, instead of being made up of the general public, was chiefly composed of well-known *savants*, professors, and students. Thus the object of the *soirées*—namely, the popularisation of science, or the general dissemination of it—is not answered, the public taking little notice of the interesting facts and speculations of science.

An enterprise has lately been set on foot for the manufacture of guano from fishes. The refuse from fisheries has been for some time past employed in this manner; but it is now proposed to organise fisheries for the purpose of manufacturing the article, which possesses several advantages, decomposing neither too quickly nor too slowly, and exhaling no ammonia. I think I have heard that similar projects have already been started in England.

A new ear trumpet for the deaf, a short description of which appears in the *Union Médicale*, has been invented by Dr. Communal. It is said to possess great advantages, rendering the sound clear and distinct, without fatiguing the persons who use it.

M. de Waldee, who has lived for some time among the ruins of Palenqué, situated in a forest filled with venomous reptiles, succeeded in preventing death from bites of these animals by enlarging the wound immediately by a lancet, introducing butter of antimony, applying a ligature tightly above the wound, and taking ten drops of ammonia in a glass of water every quarter of an hour for twelve hours. Four of the Indian workmen employed by him, who did not employ these remedies, died very soon, but himself and servant escaped through the foregoing treatment.

A Spanish photographer has discovered a varnish which gives an astonishing brilliancy to the prints to which it is applied. He keeps his invention secret, but the varnish is believed to consist of albumen. M. R. P. Matthys, however, has produced a similar effect by means of a layer of collodion spread over the finished print. The result is said to be very pleasing.

MM. Plucker and Hittorff have succeeded in producing spectra of two orders of nitrogen, oxygen, phosphorus, sulphur, and selenium. The two orders of spectra are obtained with a Rhumkorff's coil, the gas being placed in a tube at a pressure of a few centimetres. With the spark from a Leyden jar only one spectrum was obtained. The spectrum of less refrangibility is produced by the gas at a comparatively low temperature, and has a yellow colour; that of greater refrangibility, produced by a higher temperature, has a violet colour. A combination of prisms is employed for the production of the spectra. A peculiarity of the less refrangible spectrum of nitrogen is that it is traversed longitudinally by black lines. The more refrangible is composed of brilliant lines on a more or less obscure ground. To produce the sulphur spectra, a few pieces were placed in the tube which was heated. Carbon vapour gave only the less refrangible spectrum. The most complete spectrum was produced by burning cyanogen in oxygen.

Analytical chemistry is often to a great extent at fault when adulterations form the subject of investigation; this is more especially the case with oils. M. Sorchon has determined with great care the indices of refraction of several essential oils with a view to the detection of admixtures. In cases in which the indices of refraction are nearly equal, circular polarisation can generally be employed to distinguish between different oils.

In the *Journal de l'Anatomie et de la Physiologie* for March is an account of the physiological action of aconitine upon man, and a comparison of its properties with those of aconite. A list of general results is given, from which it appears that aconitine is a narcotico-irritant poison; that it is absorbed more rapidly than strychnine by the digestive tube, which accounts for the rapidity of its action; acts on the nervous centres; that the symptoms are observed in the following succession:—Stoppage of respiration, of general sensibility, of reflex sensibility, and of voluntary movements; that the action of the heart is stopped by its action on the substance itself of this organ; that the effects on the peripheral nerves succeed to those on the central organs; that the excitability of the nervous filaments disappears in the peripheral parts before the nervous trunks lose their sensibility. A good diagnosis by which different poisons could be distinguished by the symptoms would be of great value to medicine; it would also be advantageous to have general systems of treatment for different poisons, which should be divided into classes; much has been already done in this respect, but there is still room for further investigation. There is also an article on the various modes of formation of organised matter in general, and of anatomical elements in particular. The highly-interesting subject of histology is making rapid advances, although it is comparatively but recently that it has attracted the attention of investigators.

Constant Voltaic Battery.

To the Editor of the Chemical News.

Sir,—I shall feel obliged to any of your readers who will give me some information concerning a modification of the voltaic battery which has recently been introduced in conjunction with a small electro-magnetic apparatus, as a substitute for the ordinary domestic bell. The battery is a single-fluid one, consisting of a zinc and carbon element, immersed in a transparent, colourless liquid, but at the bottom of the jar is a pulverulent solid substance. The batteries are of French construction, and I am informed that the alarums they are used to bring into action have almost superseded the usual system of bell-hanging in the clubs and hotels of Paris. It is said that one of these cells will remain in action and perform its duty without any attention for more than a year, and I have had one under my own observation for three months which works as well now as it did at first.

Analysis of the solid substance contained in the cell showed it to be simply persulphate of mercury.

I presume the action of this salt to be as follows:—The powder is supplied dry in the cell, and the purchaser fills up the jar with water. Part of the persulphate is thus decomposed into an acid salt, which dissolves, and a basic salt, which remains insoluble. When contact between the poles of the battery is established, the acid salt is in its turn decomposed into sulphuric acid, which unites with the zinc, and metallic mercury, which precipitates on the same metal, and preserves it from local action. As the acid salt becomes thus exhausted, a new portion of the solid persulphate is decomposed, and thus the action is maintained, terminating only when metallic mercury and sulphate of zinc have replaced all the metallic zinc and sulphate of mercury.

In the belief that this view was correct, I constructed a battery on the plan described, and excited it with persulphate of mercury; I find it works very well for some time, but there is from the first considerable local action—the zinc is rapidly dissolved, and at the end of three weeks or a month all electrical action ceases, evidently from the fluid becoming saturated with sulphate of zinc.

Can any of your readers either refer me to a description of this battery, or inform me how it is that the French one retains unimpaired action for so long a time, and whether I have misapprehended any essential point in its construction or in the composition of the exciting substance?

I am, &c. Harry H. Draper.

Dublin, April 5.

Radicle v. Radical.

To the Editor of the Chemical News.

Sir,—I regret to see that you advocate the use of the word "radical" instead of "radicle." Now it seems to me, with the most humble submission, however, to editorial authority, that "radicle" is the proper word. My reason for this view is that "radicle" is a substantive form derived from *radiculus*, whereas the last syllable of the word "radical" shows its adjective origin. Another reason might be shown in the fact that the etymological and chemical meaning of the word radicle are identical. The common sense of the matter seems to indicate that we call cyanogen a "radicle," because it is the "little root" from which the cyanogen compounds proceed, and not because cyanogen is "rooted" or "inbred."

The English substantive form "radical," from "*radicalis*," is, it is true, used to express a person afflicted with that dread political disorder "*morbus Brightii*," but this, I conceive, is because such an individual is anxious to make "radical" changes in existing institutions, and not because he is a "little root," unless, indeed, it be of a large amount of evil for the community generally.

In treating of English etymology I am aware that analogy goes but a very little way; the process by which the word "principal" became a noun may, however, be brought forward with good effect. "Principle," we all know the meaning of; "principal" used as an adjective is also plain; but "principal" used as a substantive, as in "principal" of a college, has evidently originated from the adjective through the gradual elimination of the word "master" or "professor." The use, therefore, of "radical" in chemistry ought to point to the ellipsis of some substantive formerly joined to it, which I do not think has ever been the case.

I believe it is usual when a presumptuous correspondent dares to differ from an editor always to "appeal to the sense of justice so often displayed in his valuable journal," and threaten to send a copy of the letter to some rival organ, both of which salutary customs I beg to comply with. I am, &c. C. W. Q.

Gas Explosion at Utrecht.

To the Editor of the Chemical News.

Sir,—I observe in your valuable periodical that a singular dispute is carried on between Professor Mulder, of Utrecht University, and several other chemists, as to the danger of using, in the manufacture of gas, coals damaged by sea water. Soon after the accident alluded to, I minutely examined the works, and, as a matter of course, my conversation with the manager turned to the cause of the explosion. Without desiring to speak in the least in a disparaging manner about Professor Mulder, I think the cause of the explosion can be accounted for in a far more simple and plausible manner than by coming to a rather so-far sought cause as Mulder does. I will first detail the particulars which I learned while at Utrecht, and then discuss in how far Mulder's theory can be of any avail in this instance. The gasworks were started in September, 1862, but there was a defect in the tanks of the gasholders, which prevented the latter being employed to their full capacity. In consequence hereof the manager experienced, during the long winter nights, considerable difficulty in keeping up the supply of gas; and this difficulty was overcome by increasing, during the first hours of the evening, the number of working retorts. At the latter end of December, 1862, it appears the manager was absent from the works for a couple of days, and as far as I understood he was absent on the night when the explosion took place. The explosion was not exactly in or about the purifiers (dry lime), but proceeded from the purifier house, and the manner in which gas escaped is simply enough accounted for. It is in the first place more than probable that the workmen had packed the lime in too moist a state* on the perforated frames or grates of the purifiers, and had not also, as it would appear, taken sufficient care that the water in the brim of the purifiers was sufficiently filled to prevent an escape of gas after the lowering of the purifier cover. But moreover, it appears that more gas was passed or forced through the purifiers than they were intended to carry in a given time; hence over-pressure and the gas not being able to make its way through the lime, blew off what water yet remained between the purifier cover and the external and internal brim of the former, and found its way in the house where there was no sufficient ventilation, and unfortunately not far distant a gas-flame unprotected by wire gauze, and thus the explosion—the gas being, of course, mixed with air—took place, seriously injuring the building, and, if I recollect aright, also damaging one of the purifier covers. The cause of the escape of gas is by no means a complicate cause at all, as Mulder would make it, and it is very questionable whether the reason assigned by him is at all likely to cause the result he would make us believe it had. Granting for the moment that hydrochloric acid† is evolved along with gas, if coals injured by sea-water are used in its manufacture, then it must not be lost sight of that, first, ammonia is also a product of the distillation of coal; and, second, that the gas previous to entering the purifiers at the Utrecht gas-works passes through a system of pipes for condensing tar, then enters a washing vessel, and next a scrubber filled with coke and where the gas is made to meet with a stream of cold water which falls upon the coke, the gas entering from the bottom and proceeding towards the top of the scrubber. Only after this the gas enters the purifiers, and considering the solubility of hydrochloric acid in water—the presence of ammonia and other volatile alkaline products of the distillation of the coal, it is not only very unlikely, but almost impossible, that any hydrochloric acid should have been left to enter the purifiers; and even if there were some, it cannot but be a minute trace, and that while being absorbed by the lime in the purifiers will not possibly be able to form chloride of calcium to such an extent as to choke the pipes leading to and from the purifiers. I am, &c.,

Dr. A. Adriani.

MISCELLANEOUS.

Chemical Society.—The next meeting of this Society will be held on Thursday next at eight o'clock, when the following paper will be read:—"Philosophy of British Agriculture." By Mr. J. T. Way.

New Work on Blow-pipe Analysis.—As everything relating to the progress of science in our dependencies is of interest in the mother country, we are happy to announce that a work on blow-pipe analysis, which will contain a good deal of new matter, is in course of preparation by Mr. Chapman, of University College, Toronto, Canada.

Experiments on Respiration of Plants, &c.—At the last meeting of the Munich Academy of Sciences, Baron Liebig presented an interesting paper on certain experiments he had made with an apparatus constructed at the expense of the King of Bavaria for estimating oxygen in various bodies. These experiments prove that not only is oxygen disengaged from the atmosphere by plants, but also, and in considerable quantities, by the decomposition of water in the bodies of carnivorous animals. Baron Liebig is of opinion that this fact will throw new light on the phenomena, still so little understood, of nutrition and digestion.—*Moniteur Scientifique*, v. 881, 63.

Nature Printing from Steel.—Mr. Sorby, F.R.S., of Sheffield, describes a new process for printing the texture of "blister" steel, in a letter to the *Quarterly Journal of Science*. He says:—"When iron is converted into steel by cementation, three distinct crystalline compounds are formed, two of which are readily dissolved by diluted nitric acid, whereas one is scarcely at all affected by it. If, therefore, a piece of such steel be ground flat and polished, and then placed in the acid, after a suitable amount of action, this constituent retains its original surface and polish, whereas the other two are so much dissolved that it stands up in sufficient relief to allow of the blocks being used for surface printing instead of a woodcut, to exhibit the structure of different varieties of steel." [The letter is illustrated with a small imprint thus produced.]

ANSWERS TO CORRESPONDENTS.

A Subscriber.—No.

Reader.—1. Not at all likely to succeed. 2. See p. 48 of Dr. Hofmann's "Exhibition Report."

R. S. and A. B.—1. The "Examples of Qualitative Analysis" can be obtained from the College, Cirencester. 2. The price of the chart is 2s. 3. The publication of the Cantor lectures will be commenced when all have been delivered.

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[*] The lime used in the so-called dry lime purifiers is slaked lime moistened with a sufficient quantity of water to be perceptibly humid, but still able to be passed through a not too small meshed riddle. The chemical action which commences after the gas passes through causes the lime to swell and to harden considerably; so that if care is not taken to place the lime lightly on the grates, it may happen that either the passage of the gas through the lime is stopped altogether, or, at least, rendered very difficult, thereby increasing the pressure, which it is just intended to avoid by the use of dry lime purifiers.

[†] When a quantity of salt is thrown in a blazing coal fire, or on the burning coals of a steam-boiler furnace, the smoke accompanying the combustion under ordinary circumstances is quelled, but hydrochloric acid escapes from the chimney. I do not see how in gas retorts chlorine could be evolved unless in combination with hydrogen.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

The Assay of Tin Ores, by Clemens Winkler.[*]

The author mentions the well-known difficulty of obtaining all the tin in one button in a dry assay by the ordinary process, and the error of 5 or 10 per cent. which arises. To avoid this loss, he suggests the addition of copper for the purpose of collecting together the tin, and states that he has obtained tolerably accurate results by the following process :—

The ore is finely pulverised and roasted, first by itself and then once or twice with charcoal or coke, to remove sulphur, arsenic, and antimony. The residue is then digested for a quarter or half an hour with hot hydrochloric acid, and afterwards well washed with hot water. Iron, manganese, and copper, he states, are more completely removed by fusion with bisulphate of potash, and then treating with hydrochloric acid, and washing with water. Tungstic acid, if present, will now be removed by digesting with caustic potash or ammonia.

The oxide of tin, silica, &c., remaining is now mixed in a crucible with an equal weight of peroxide of copper, and two or three parts of flux, consisting of two parts anhydrous carbonate of soda, one part white flour, and a quarter part borax glass. The whole is then covered with a layer of common salt, upon which a piece of charcoal is laid. The crucible is then heated first to a red and then to a dull white heat for an hour, after which a button containing the whole of the tin and copper reduced will be found at the bottom.

As pure peroxide of copper may not be obtainable, the author recommends that a portion of every sample should be separately assayed.. The weight of the tin will be found by subtracting the weight of the copper from that of the button.

On the Estimation of Copper and the Assay of Impure Commercial Cyanides of Potassium,

by M. Flajolot.

This process is founded on the property possessed by cyanide of potassium of decolourising the ammoniacal solution of oxide of copper. The decolouration takes place with great precision, and as no precipitate is formed in the liquid it is very easy to ascertain the moment at which it is complete. The numerous experiments I have made with previously weighed quantities of copper have always given remarkably precise results, which I was far from expecting in the earlier experiments. In operating on a solution the volume of which did not exceed 200 cube centimetres, the error does not exceed two milligrammes, a degree of precision unattainable even by precipitating oxide of copper by potash. But to render the process applicable there must be in solution with the copper none of the metals forming cyanides soluble in ammonia, especially zinc, cobalt, and nickel.

In assaying complex ores like grey coppers, or those which have blende or nickeliferous pyrites for gangue, the copper must first be separated from the other metals.

This is easily done by precipitating copper in the state of sulphide by hyposulphite of soda, as I have indicated in the *Annales des Mines*, fourth series, vol. iii. p. 641.

In this kind of analysis I proceed in the following manner:—Let us take grey copper mixed with blende, galene, or all the gangues which may accompany copper ore.

Attack the finely pulverised ore by a mixture of nitric and sulphuric acids in a porcelain capsule, covered by an inverted funnel to avoid projections, and evaporate until the whole of the nitric acid is expelled; then add water and evaporate if necessary; then pour into the boiling solution hyposulphite of soda until the dark tint which at first occurs disappears. The precipitation is known to be complete when the sulphide of copper collects in flakes, floating in a milky liquid. Collect on a filter the sulphide (which will not contain the least trace of iron, zinc, cobalt, nickel, or even lead, but which may contain a little arsenic and antimony), and wash it very rapidly with hot water to prevent oxidation in the air.

Re-dissolve the sulphide in aqua regia, not heeding the antimony and arsenic it may contain, for they do not affect the following reaction. Supersaturate the liquid with ammonia, and pour into it until the colour goes a standard solution of cyanide of potassium, which gives the quantity of copper. The témperature of the cupric solution should not be too high, for less cyanide is required at the boiling point than when cold; up to 40° C. no inconvenience is experienced. Sufficient cyanide of potassium has been added when the blue colour of the liquid gives place to a very faint rose tint.

I use a solution of 15 grammes of cyanide in 50 grammes of water, and determine the standard by dissolving a given quantity of pure copper, say five decigrammes, adding ammonia, and operating as I am about to describe. Since the solution of cyanide of potassium rapidly alters, it should be estimated before each assay.

Ammonide of copper becomes completely decolourisd when there are two equivalents of cyanide of potassium for one of copper, which corresponds to 4·12 grm. of cyanide to one gramme of copper.

If, then, on the one hand, we dissolve 1.12 grm. of cyanide of potassium or testing assay in a little water, and, on the other hand, prepare a solution of ammonide of copper containing one gramme of metal and filling 100 divisions of a graduated burette, and then pour the second solution into the first, until a blue colour begins to appear, it is evident that the number of divisions necessary to produce this result will give in centièmes the richness of cyanide assayed, for the salts mingled with it exert no decolourising influence on the ammonide of copper.

But the operation is easier, the reaction more distinct, by proceeding inversely. For instance, dissolve one gramme of copper in a little nitric acid and odd excess of ammonia. Dissolve 8·24 gr. of the cyanide to be tested, so as to have a volume of 200 cubic centimetres, then add this liquid to the first until the colour disappears. It is evident if 22 cubic centimetres are required, the richness of the cyanide is $\frac{100}{22}$. Now that so much cyanide of potassium is manufactured for commercial purposes, so simple and easy a process may prove useful.—*Moniteur Scientifique*, v., p. 78.

American Adulteration.—A parcel of opium, some of which consisted of cakes evidently unbroken, was lately delivered to a laboratory in Philadelphia; one of the cakes, previous to being prepared for drying, was broken, and found to contain sixteen leaden bullets, weighing $7\frac{1}{2}$ oz., evidently incorporated for increasing the weight.

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[*] *Berg und Hutten, Zeitsch*, 3, 1864, and *Mining and Smelting Mag.*, April, 1864.

TECHNICAL CHEMISTRY.

On a Means of Obtaining Bismuth, by M. Balard.

The high price of bismuth for some years past has induced M. Balard to undertake the search for this metal in old type materials. When it was cheaper, bismuth entered into the composition of the alloy for printing purposes. M. Balard proposes to effect this industrial analysis in the following way:—

1. Dissolve the material in nitric acid, so as to transform all the tin into metastannic acid, which isolate by filtration from the acid solution of nitrates of lead and bismuth; wash with acidulated water, dry and reduce by charcoal.

2. Into the liquid, neutralised as much as possible, plunge plates of lead, which precipitate all the bismuth in a metallic state; dry and melt with a reducing agent.

3. Precipitate the lead from the last liquid by carbonate of soda; separate, wash, dry and reduce with charcoal.

This way of operating gives the three metals in a metallic state; it may undergo several modifications for isolating the metals under another form according to the arrangement of the products. To obtain extremely pure subnitrate of bismuth, says M. Balard, it is necessary only to neutralise the liquid containing the soluble nitrates, and dilute with a large quantity of water naturally free from carbonates, chlorides, or sulphates. After again neutralising and diluting with water and repeating the operations several times, the greater part of this metal becomes isolated in the state of white bismuth.—*Journal de Pharmacie et de Chemie*, xlv. 160.

Extraction of Auriferous Silver from its Ores, by M. J. Nickles.

Though the treatment of argentiferous ores is easy, and that of auriferous ores not very complicated, it is otherwise when the two metals are associated, for then the properties of the one prevent the manifestation of the properties of the other. If, for instance, auriferous silver is treated by chlorine water, the core immediately becomes covered with a coating of chloride of silver, which protects the rest from the action of the solvent. If this is attacked by salt water, ammonia, or hyposulphite of soda, the core becomes unmanageable, the chloride of silver dissolves, it is true, but leaves behind it a layer of metallic gold which in its turn resists the action of the solvents of chloride of silver.

After many tentative trials the simple plan occurred to the author of associating the two solvents, chlorine and chloride of sodium. He took salt water concentrated and saturated with chlorine, and digested the auriferous alloy in it. By burning an ore of this kind and then washing it with the above solvent, the chlorine attacks the metallic particles, and then transforms them into chloride, which is dissolved by the sea salt.

It is thought that this solvent may serve for the treatment of ores so poor in metals as to be discarded for the ordinary extracting processes.—*Polyt. Notizblatt*, vol. xviii. p. 286.

Royal Institution.—Tuesday, April 26, at three, Professor Blackie, "On Homer." Thursday, April 28, at three, Professor Blackie, "On Homer." Friday, April 29, at eight, Professor Williamson, "On the Existence of Atoms." Saturday, April 30, at three, Professor Frankland, "On the Metallic Elements."

PHYSICAL SCIENCE.

Spectrum Analysis.—New Researches, by MM. Mitscherlich, Böettger, Plucker, *and* Hittorf.

A *resumé* of the many interesting researches on spectrum analysis made since its discovery may now be of interest.

While examining a substance containing baryta, M. Mitscherlich* observed two brilliant green rays, seeming to indicate the presence of a new metal. When he introduced into the flame a drop of a solution of chloride of barium mixed with sal ammoniac, he found that these rays appeared either singly or accompanied by those of barium. These same rays took the place of the ordinary barium spectrum, when, above the supporter of a salt of baryta, he placed a bundle of platinum wire impregnated with hydrochloric acid. M. Mitscherlich obtained invariable spectra during several hours by a particular arrangement pointed out in his memoir.

Chlorides of strontium and calcium give spectra very different from those of strontium and calcium, although these new spectra are rarely unaccompanied by those of the metals.

Chlorides of earthy alkaline metals give spectra very unlike the spectra of the metals themselves. The iodides, sulphides, and fluorides of these metals yield no spectra, or, rather, they give those of the metals which are reduced by the carbon and hydrogen of the flame.

The spectra of metallic copper, of chloride, and iodide of copper present essential differences. Sulphide of copper gives no spectrum.

Chloride of potassium mixed with sal ammoniac gives no spectrum. Chloride of sodium, under the same circumstances, shows only the yellow sodium ray. On introducing a bundle of platinum wires, steeped in hydrochloric acid, into a flame giving potassium rays, these rays immediately disappear.

Chlorides of potassium and sodium have no proper spectrum. The result of these experiments is, that metals do not, as is usually supposed, always give the same spectrum, whatever may be the combinations in which they are found.

M. Mitscherlich has proved by the following experiment that it is the metal itself reduced in the flame which produces the spectrum. He introduced some caustic soda into a porcelain tube, heated it to redness, and on examining by the spectroscope the light traversed by the vapours and that emitted by them, found that neither of them showed the sodium line; but on examining the vapours of metallic sodium, under the same conditions, found a brilliant sodium ray.

M. Bœttger observed† that selenium and selenide of mercury gave a spectrum, in which he remarked, from yellow to extreme violet, a great many equidistant dark rays.

Coal gas, after passing through a flask containing chloroform, burns with a green flame, which, analysed by the spectrometric apparatus, shows two blue rays close together, three large green rays comprised between Fraunhofer's rays D and C, and a large blue ray situated between the rays F and G.

Borax gives three or four green rays; protochloride of manganese, four green, and one large orange ray; chloride of bismuth gives numerous brilliant red and blue rays, which rapidly disappear; and chloride of lead gives a number of rays distributed over the entire spectrum.

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* *Bulletin de la Société Chimique.*

† *Bulletin de la Société Chimique.*

M. Erdmann remarked that lime showed a blue ray close to the ray β of rubidium, which might prove a source of error to chemists. According to Dr. Gladstone, didymium may be known by two black rays, one near the ray D, the other between E and C. If the solution of didymium is from eight to ten centimetres thick, seven black rays of various sizes will be visible.

MM. Plucker and Hittorf,‡ in recent experiments, proved that certain bodies, such as nitrogen and sulphur, do not give a unique spectrum, but, according to the temperature to which the incandescent vapour is submitted, two very different spectra. To ascertain this, they passed through the tubes, containing gas or vapour at a pressure of a few centimetres, first the ordinary current of Ruhmkorff's induction coil, then the same current with its calorific action increased by the interposition of a Leyden jar. By varying the surface of the jar, and thus gradually raising the temperature of the gaseous body, they found that the transition from one spectrum to another was suddenly accomplished. Thus an essential modification most evidently have taken place in the molecular constitution of the body; but with the lowering of the temperature the difference disappeared.

The spectrum corresponding to the lowest temperature, and which MM. Plucker and Hittorf name the first spectrum, is formed of large bands more or less regular, oftener presenting the appearance of channelled spaces cut by black rays. The second spectrum, corresponding to the higher temperature, has brilliant rays on a more or less luminous ground. The brightness changes from one ray to another, quite irregularly.

Sulphur furnishes a striking experiment, showing the abrupt passage from one of the two rays to the other. At the moment the first spectrum attains its maximum of brightness, it suddenly disappears, and gives place to the second spectrum, the richest in brilliant rays which the authors have ever seen. On lowering the temperature the second spectrum disappears and the first reappears.

Oxygen, chlorine, bromine, iodine, &c., have one spectrum only.

To render more precise this entirely new fact, of two absolutely distinct spectra belonging to one simple body, MM. Plucker and Hittorf have studied the spectra of compound gaseous bodies. They have ascertained by spectrum analysis that none of the bodies examined by them resist decomposition by means of the heat from an induction current. Dissociation always took place; the tubes and the molecules of the various simple substances which constitute the compound gaseous body remain under conditions the most favourable to recomposition, as soon as the extreme elevation of the temperature no longer opposes it. It may then be affirmed that there is no such thing as a spectrum of a compound body. Thus, oxide of carbon, carbonic acid, olefiant gas, &c., decompose, and give the spectrum of carbon vapour, one of the most beautiful and curious to behold.

According to MM. Plucker and Hittorf, nitrogen has three spectra, or three different molecular conditions. In the two first conditions nitrogen gives two distinct first spectra, one of a yellow colour, corresponding to the less degree of incandescence; the other, to a higher degree of incandescence, of a blue colour. In the third molecular state, produced by a much more intense state of incandescence, the second spectrum appears.—*Journal de Pharmacie et de Chemie*, xliii., 442.

PHOTOGRAPHY.

Preparation of Alkaline Bromides, by M. KLEIN.

BROMIDES of metals of the first section being most used in photography, the author has endeavoured to find a way of preparing them more expeditious than those generally adopted, and it occurred to him to apply a process M. Liebig employs for producing alkaline iodides.

Bromide of Calcium.—Mix one part of finely powdered amorphous phosphorus with thirty or forty parts of water in a capsule placed under the basket-funnel, and gradually add 12·5 parts of bromine. The mixture is effected with disengagement of light, and the liquid becomes heated; then shake it and add the bromine until the mixture begins to decolourise. When all the bromine has been used, heat in a sand bath; and when all the colour has disappeared, add sufficient bromated water to impart a yellow tinge to the solution. Then decant immediately, and neutralise by a slight excess of lime. Filter, wash, and evaporate. The excess of lime carbonates in the meanwhile, which necessitates a second filtration, after which evaporation in a water bath completes the operation.

With 16 grains of amorphous phosphorus, 200 grains of bromine, and about 75 grains of quicklime, the author obtained 230 grains of bromide of calcium. Bromides of barium and strontium may be prepared in the same way.

Bromide of Magnesium.—Neutralise with magnesia the acid liquid obtained by attacking 1 part of phosphorus by 12·5 parts of bromine in presence of water. After filtering, evaporate in a water bath and dry over sulphuric acid.

To Obtain Bromide of Lithium.—Decompose bromide of calcium by carbonate of lithia used at first in insufficient quantities. Leave to digest for twenty-four hours, after which finish the precipitation by carbonate of lithia.

Bromides of potassium and sodium the author obtains by a process previously described for iodides (*Journal de Pharmacie et de Chemie*, xli. 520), that is to say, by the decomposition of bromide of calcium by means of sulphate of potash or soda.—*Journal de Pharmacie et de Chemie*, xlv. 111. 64.

Microscopic Examination of Milk in Health and Disease.—It must be some consolation to those who delight in miserable anticipations of dreadful mixtures in their daily food to know that we possess a method of detecting, with absolute certainty, those combinations of "brains, chalk, and starch," a haunting suspicion of which makes the morning and evening meal distasteful. Without positively asserting that such adulterations never exist, we may aver that we have never met with an instance. Foreign matters, of a nature unsavoury enough, and even unwholesome, we sometimes find, but they are the consequences of a diseased condition, or of an absence of common cleanliness. Such things as particles of dirt, from the milker's hands or the cow's udder, and cuticular scales from the same sources, are common enough. Globules of pus and blood discs are also found less frequently, but still oftener than we like to believe. It will not be thought that the microscope should be the companion to the breakfast-table; but in all cases where there is the least cause for suspicion, its revelations are infallible, and set at rest the doubt that is worse than certainty.—*Dr. Augustus Voelcker, in the Quarterly Journal of Science.*

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‡ *Les Mondes.*

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

WEEKLY EVENING MEETING.

Friday, February 12, 1864.

Sir Henry Holland, *Bart., M.D., D.C.L., F.R.S., Vice-President, in the Chair.*

On the Synthesis of Organic Bodies.

By J. Alfred Wanklyn, Esq., Professor of Chemistry, London Institution.

On this tray you will see a collection of well-known substances.* Compare these substances with one another, and you will be struck with their dissimilarities. Some are solids and crystalline and brittle; others are liquids which are more fluid than water. Some are without colours; others are highly coloured, and are used for dyeing. Some are sweet, others are bitter; some have delightful perfumes, others have dreadful smells; some are wholesome food, others the most powerful poisons known to man.

In spite of this wonderful diversity in their properties, all the specimens on this tray are compounds of carbon, with a very few elements. Carbon, hydrogen, oxygen, and nitrogen are the only elements which occur in this collection of substances. Some of these substances contain carbon and hydrogen; some contain carbon, hydrogen, and oxygen; some carbon, hydrogen, and nitrogen; and some again contain carbon, hydrogen, oxygen, and nitrogen. But not one of the specimens on this tray contains anything besides these four elements.

There is no difficulty in resolving any one of these substances into its ultimate elements. This sugar,† for example, on being heated to redness in a tube, leaves a black deposit, which is carbon, whilst a liquid, which is water, distils over. If we were to electrolyse this liquid, we should obtain hydrogen and oxygen, and so we should exhibit carbon, hydrogen, and oxygen obtained from sugar. Again, instead of heating this sugar in the tube without allowing the air free access to it, we might burn it in excess of oxygen. If we were to do so, we should obtain carbonic acid and water, and, moreover, all the carbon in the sugar would assume the form of carbonic acid, and all the hydrogen the form of water. So we can obtain carbon and hydrogen, either in the free state, or in the very common and well-known forms of combination as carbon acid and water. Nitrogen, when it is present, can be made to assume the form of free nitrogen. For that purpose, all that is requisite is to heat the substance to redness with excess of oxygen, and to adopt certain precautions to avoid the production of oxide of nitrogen.

Thus, the pulling to pieces of these substances on the tray is a matter of very little difficulty: more than fifty years ago chemists could do that; but how to put the pieces together again is a much more difficult task.

Sugar consists of seventy-two parts by weight of carbon, eleven parts of hydrogen, and eighty-eight parts of oxygen. We may bring together carbon, hydrogen, and oxygen in these proportions, and shake them up together, or heat them or cool them, and yet we shall never get them to combine so as to form sugar. Alcohol consists of twenty-four parts of carbon, six parts of hydrogen, and sixteen parts of oxygen, but no alcohol ever results from making such a mixture. Neither sugar nor alcohol can exist at the temperature to which it is requisite to raise our mixture of carbon, hydrogen, and oxygen, in order to get chemical action to set in. At ordinary temperature the organic elements will not enter into combination, whilst at high temperatures they combine, it is true, but yield comparatively very few compounds.

It was long after chemists had effected the analysis of organic bodies before they learnt how to effect the synthesis of even one of them, and hence the belief sprung up that organic products, such as those on our tray, were intrinsically different from mineral products. Whilst stones, water, and the like were regarded as having their ultimate particles held together by mere dead forces, sugar, alcohol, &c., were regarded as being held together by vital forces, as being, in short, in some subordinate way, alive.

Now, no more positive refutation of this notion can be imagined than the artificial construction of substances, in every respect, like those obtained from the animal and vegetable kingdoms; and hence some of the philosophical interest attached to the problem which forms the subject of this discourse.

The first definite example of the construction of an organic body from inorganic materials was given by Wöhler in 1828, when he made the organic base urea from cyanate of ammonia.

Let us trace the steps of this process. Cyanide of potassium—a body which can exist at a red heat (some cyanide of potassium was exhibited in the form of tabular masses which had been fused), and which can, moreover, be formed directly from its constituents (carbon, nitrogen, and potassium)—was oxydised by means of peroxide of manganese at a low red heat, and so cyanate of potash was obtained. The cyanate of potash was next converted into cyanate of ammonia by double decomposition with sulphate of ammonia. Thus cyanate of ammonia was produced from its elements by a process which, although indirect, still did not involve the action of either a plant or an animal. Cyanate of ammonia becomes urea when its solution in water is simply evaporated to dryness.

It was curious that the first organic body to be constructed should have been a nitrogenous compound.

In 1831, three years after this important discovery of Wöhler's, formic acid—the first term of the fatty acid series—was obtained from inorganic materials by Pelouze. The process was this:—Hydrocyanic acid, a body capable of being obtained from inorganic materials, was heated either with strong alkalis or acids, and was so made to react upon the elements of water as follows:—

$$\overbrace{CNH}^{\text{Hydrocyanic Acid.}} + 2H_2O = NH_3 + \overbrace{CH_2O_2}^{\text{Formic Acid.}}$$

and yielded formic acid.

It does not appear that this research of Pelouze's attracted that attention which it deserved. This we must attribute to the circumstance that at this period the position of formic acid in the organic series was not recognised.

The next step of importance in organic synthesis was taken by Kolbe in 1845. It was the synthesis of acetic acid, the second term of the fatty series. Kolbe's process was this:—Sulphide of carbon, obtained by the direct combination of carbon with sulphur at a red heat, was submitted to the action of chlorine at a red heat, by which means certain compounds of carbon and chlorine were obtained. One of the compounds, C_2Cl_4, was then acted upon by chlorine in the presence of water, and tri-chlor-acetic acid resulted.

Having thus got tri-chlor-acetic acid by thoroughly inorganic means, Kolbe availed himself of the observation which had been made of *Melsens*, that treatment of tri-chlor-acetic acid with potassium-amalgam and water converted it into acetic acid.

Kolbe was fully sensible of the scope and importance of his discovery. The following passage occurs in his paper, published in Liebig's *Annalen* for 1845:—" From the foregoing observations we deduce the interesting fact that acetic acid, hitherto known only as a product of the oxidation of organic materials, can be built up by almost

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[*] A tray, with a number of organic bodies lying upon it, was before the speaker.

[†] Cane sugar was heated to redness in a tube.

direct synthesis from its elements. Sulphide of carbon, chloride of carbon, and chlorine are the agents which, along with water, accomplish the transformation of carbon into acetic acid. If we could only transform acetic acid into alcohol, and out of the latter could obtain sugar and starch, then we should be enabled to build up these common vegetable principles by the so-called artificial method from their most ultimate elements." Thus it appears that Kolbe looked forward to the building up of organic bodies in general, and that he was quite alive to the fact that the synthesis of acetic acid completed the synthesis of the derivations of acetic acid.

Among these derivations may be enumerated acetone, the product of the destructive distillation of acetates; marsh gas obtained by distilling an acetate with a caustic alkali; ethylene, obtained by Bunsen by heating kakodyl, which itself results by the action of arsenious acid upon an acetate. The electrolysis of acetic acid, which Kolbe accomplished a few years afterwards, yielded methyl and oxide of methyl, which latter in its turn could be transformed into any other methylic compound.

Marsh gas was, moreover, prepared by Regnault by treating CCl_4 with nascent hydrogen; and the common methylic compounds appear to have been produced by Dumas from marsh gas, the chloride of methyl having been obtained by Dumas, by the action of chlorine upon marsh gas.

Before 1854, all the foregoing synthesis were fully completed, *i.e.*, there was no step missing between the elements themselves and the most complex compound reached; but, in addition to these complete and definite syntheses, there had also been a good deal of building up of an incomplete or of a less definite character before 1854.

It was known, in a general way, that organic bodies of tolerably simple composition sometimes gave complex products on destructive distillation. Thus, alcohol was known to give naphthaline, benzol, and carbonic acid when it was pressed through a red-hot tube. Formiates were also known to yield hydro-carbons when they were subjected to destructive distillation. The precise dates of these different observations I cannot give, but hand-books of chemistry published before 1854 contain a statement of the facts.

A few years after 1820, before Wöhler's celebrated Synthesis of Urea, a very remarkable instance of passage from a simpler to a more complex compound was given by Faraday and Hennell. This example is placed along with the indefinite syntheses because it was generally disbelieved in by chemists, and only within the last few years, when it was confirmed by Berthelot, received the general assent. Faraday and Hennel found that olefiant gas was absorbed by sulphuric acid and gave sulpho-vinic acid, from which, of course, alcohol and the ethers might be procured. Liebig denied what Faraday and Hennell had asserted, and the latter did not insist upon the correctness of their work, and did not take the necessary steps for ensuring the reception of their results.

Shortly before 1854 a most capital addition to the art of organic synthesis was borrowed from the doctrine of the homologous series. I will endeavour to explain it.

Organic bodies repeat themselves: thus common alcohol has a whole series of representatives, differing from it in formula by *n* (CH_2), but resembling it very closely in chemical functions. Alcohol and these its representatives constitute a homologous series. Every one of these representatives (homologues) of alcohol possesses a set of ethers and other derivatives, just as common alcohol possesses its ethers and derivatives. With certain limitations, it is true that whatever reaction can be accomplished with one alcohol can be accomplished with any other alcohol of the series.

Synthesis by series will then be easily understood by an example. Suppose we obtain a building-up by starting with common alcohol, we should infer that an analogous building-up could be made by starting with any other alcohol of the series.

Here follows a table of the homologous series of alcohols, and of the homologous acids which are related to them:—

Methyl	alcohol	$C\,H_4O$	$C\,H_2O_2$	Formic	acid.
Ethyl	,,	C_2H_6O	$C_2H_4O_2$	Acetic	,,
Propyl	,,	C_3H_8O	$C_3H_6O_2$	Propionic	,,
Tetryl	,,	$C_4H_{10}O$	$C_4H_8O_2$	Butyric	,,
Amyl	,,	$C_5H_{12}O$	$C_5H_{10}O_2$	Valerianic	,,
Hexyl	,,	$C_6H_{14}O$	$C_6H_{12}O_2$	Caproic	,,
,,	,,	,,	,,	,,	,,
Cetyl	,,	$C_{16}H_{34}O$	$C_{16}H_{32}O_2$	Palmitic	,,
,,	,,	,,	,,	,,	,,
Ceryl	,,	$C_{27}H_{56}O$	$C_{27}H_{54}O_2$	Cerotic	,,

A good example of synthesis by series was furnished by Frankland and Kolbe, who showed that various cyanides of the alcohol-radicles yield the next higher acid in the series when they are digested with an alcoholic solution of potash, thus:—

$$\overset{\text{Cyanide of Methyl.}}{\left.\begin{matrix}C\,H_3\,CN\\+\ 2\,H_2O\end{matrix}\right\}} = \overset{\text{Acetic Acid.}}{\left\{\begin{matrix}C_2H_4O_2\\+N\,H_3\end{matrix}\right.}$$

The effect of the alkali is to cause decomposition of water by means of the cyanide, and the reaction very closely resembles Pelouze's, of which mention has already been made.

By means of this synthesis, which is general to the whole series, chemists acquired a method of ascending from any given alcohol to the acid belonging to next higher alcohol. It will be evident, however, that this step, important though it was, did not suffice to enable chemists to march regularly up the ladder. The step from acetic acid to alcohol—from an acid to an alcohol of the same carbon-condensation—was wanting.

This synthesis by series was an incomplete synthesis; there was a gap requiring to be filled up, in order that the regular march might be made up the vinic series.

From the foregoing, it will be seen that by the year 1854 very considerable progress had been made in the building-up of organic bodies from their ultimate elements.

We now pass on to the consideration of the period comprising the last ten years, from 1854 up to the present time.

During this period we have had new methods of accomplishing some of the syntheses which had been effected previously. Thus, formic acid, which, as we have seen, had been formed from inorganic materials so long ago as 1831, was built up by Berthelot by means of carbonic oxide and caustic potash,—

$$CO + KHO = CHKO_2$$

and again by Kolbe, by using carbonic acid, moisture, and sodium (the moisture and sodium giving nascent hydrogen),

$$CO_2 + H + Na = CHNaO_2.$$

Again, also, the passage from an alcohol to the next higher acid was repeated. Carbonic acid and a compound of an alcohol radicle with an alkali metal coalesced, and formed a salt of a fatty acid, thus:—

$$CO_2 + \overbrace{NaC_2H_5}^{\text{Sodium-ethyl.}} = \overbrace{C_3H_5NaO_2}^{\text{Propionate of Soda.}}.\text{[‡]}$$

Still these reactions, however interesting they might be, were not new syntheses; they were only new methods of effecting old syntheses.

The great problem, how to step from one alcohol to that next above it, has received a general solution from Mendius. Mendius used cyanogen compounds, those hydrocyanic ethers which had already done such good service to organic synthesis, and exposed them to the action of nascent hydrogen, and so obtained amides of alcohol-radicles higher than the alcohol-radicles started from. The reaction bears a close similarity to the one which takes place between the cyanides and alcoholic solution of potash, and which, as will be remembered, enabled us to pass from the alcohol to the acid next above.

[‡] The experiment was shown, and the great evolution of heat which took place on bringing carbonic acid into contact with sodium-ethyl was apparent.

Here is a scheme to show the parallel:—

Transformation to Amide.

$$\overset{\text{iv}}{C}\left\{\begin{matrix} N''' \\ \\ C_2H_5' \end{matrix}\right. \qquad \overset{\text{iv}}{C}\left\{\begin{matrix} NH_2' \\ H \\ H \\ C_2H_5 \end{matrix}\right.$$

Transformation to Acid.

$$\overset{\text{iv}}{C}\left\{\begin{matrix} N''' \\ \\ C_2H_5' \end{matrix}\right. \qquad \overset{\text{iv}}{C}\left\{\begin{matrix} HO \\ O'' \\ C_2H_5' \end{matrix}\right.$$

In the one case nitrogen is replaced by NH_2 and H,H; and in the other by HO′ and O″.

Mendius was able to commence even with hydrocyanic acid. The steps in his synthesis are these:—

Hydrocyanic Acid to Methylamine.

(1) $CNH + H_4 = CH_3NH_2$.

Methylamine, by means of nitrous acid to methyl-alcohol: methyl-alcohol to cyanide of methyl, well-known processes being employed to effect this:—

Cyanide of Methyl to Ethylamine.

(2) $CNCH_3 + H_4 = C_2H_3NH_2$.

From ethylamine it is easy to get cyanide of ethyl, from which, by a third repetition, we arrive at the propylic stage:—

(3) $CNC_2H_5 + H_4 = C_3H_7NH_2$.

Thus the vinic series may be ascended: thus there is reason to think we may begin with so simple a body as prussic acid, and step by step proceed from one alcohol to the next above it, until we reach the fats and the waxes. There are other methods of effecting the synthesis of the alcohol series, but none of them seem to be so complete and satisfactory as this:—Berthelot has obtained alcohols by adding the elements of water to the olefines, and some of the olefines he has obtained by the destructive distillation of formiates; but it is an open question—how many olefines can be got by heating the formiates? And, at any rate, there is no precision in the preparation of olefines from formiates.

A very neat and beautiful way of preparing one olefine, viz., common olefiant gas, is, however, due to Berthelot. He exposes charcoal to the action of hydrogen at a very high temperature—the temperature of the electric arc—and then union takes place, resulting in the formation of acetylene: $C_2 + H_2 = C_2H_2$

Acetylene exposed to the action of nascent hydrogen in an alkaline liquid gives olefiant gas:—

$$C_2H_2 + H_2 = C_2H_4$$

Friedel and Wurtz have converted aldehydes and ketones into alcohols by the action of nascent hydrogen, and thence there arises another method of ascending the vinic series, and besides there are a number of other reactions which are capable of more or less general employment for the purpose of building up the alcoholic series, but which we have not time to particularise.

The alcohols having been got, many other important organic compounds follow, and there is good reason for believing that with the progress of the science all will be derived from them, so that the series of the alcohols will constitute a kind of backbone to organic chemistry.

Most modern organic researches are capable of being looked at from a synthetical aspect, for they generally disclose how to devise some organic bodies from compounds which either themselves are, or will be, capable of complete synthesis. Glycerine, the base of tha fats, has been derived from the propylic series, having been obtained, by Wurtz, by a somewhat circuitous process from propylene—the olefine of that series.

The sugars have not been, as yet, unequivocally produced, but they will be, for their connexion with the hexylic series is now placed beyond a doubt. The production of glycerides from glycerine and fatty acids is the proof that the natural fats are within our grasp. The aromatic series, with its many derivations, among which may be mentioned the wonderful aniline dyes, which rival those got more immediately from the animal and vegetable kingdoms, becomes accessible to synthesis through common alcohol, which, on being heated to redness, gives benzol and carbolic acid—members of the aromatic series.

Wurtz's compound ammonias, and, above all, the immense and wonderful development of the class of compound ammonias arising from the labours of Hofmann are the pledge that the natural alkaloids—quinine, morphine, strychnine, and their congeners—will one day be within our reach.

Glycocoll, produced by Perkin and Duppa from acetic acid, and the bases of the juice of flesh, which have been recently formed by Vollbardt and Hofmann, assure us that albumen—that essential ingredient of our food—will not elude us.

Why should those medicines and foods which we find in nature be the most useful which are possible? Would it not rather be strange if they were?

Hereafter, perhaps, medicines as much more potent than quinine, as quinine is than the extracts of the commonest herb that grows wild, may be the produce of our laboratories.

PHARMACEUTICAL SOCIETY.

April 13.

Dr. Attfield delivered the first of two lectures "*On the Relation of the British Pharmacopœia to Pharmacology.*" The lecture was devoted to a critical examination of the Pharmacopœia, with the view of showing how far the compilers had, or had not, availed themselves of the results of recent chemical and pharmacological investigations. With this purpose the lecturer proceeded to notice many of the preparations and processes, comparing the latter with others which have received the sanction of eminent chemists and pharmacologists, and introducing explanatory remarks whenever it appeared desirable. Noticing benzoic acid, Dr. Attfield regretted that the lime process had not been introduced into the Pharmacopœia, instead of the old one of sublimation. In the preparation of citric acid it was pointed out that the fermentation must be quite completed before the chalk is added, since citrate lime is apt to ferment and yield butyric as well as acetic acid. A new process altogether, the lecturer thought, was advisable for the preparation of dilute phosphoric acid, that of the Pharmacopœia being liable to accident, and the dilution of glacial acid, being on other accounts objectionable. The re-distillation of sulphuric acid he considered unnecessary, unless nitrous compounds or arsenious acid, or both, are present. The acid should, therefore, first be tested, and if arsenious acid is present without nitric acid, the latter should be added, and, after the application of some heat, the sulphate of ammonia added, and the distillation effected. Speaking of tannic acid, Dr. Attfield pointed out the importance of using the officinal ether with 8 per cent. of alcohol, since it has been shown that a much more satisfactory result is thereby obtained. The omission to direct the addition of ammonia when evaporating the solution of benzoate of ammonia was mentioned. By the Pharmacopœia process the operator is certain to obtain a bi-benzoate, as was shown long ago by Berzelius. Alluding to the process for making antimonium sulphuratum, Dr.

Attfield objected to the term "prepared" sulphuret of antimony, when only powdered was meant, and suggested that this substance should have been ordered to be freed from its ordinary impurity—sulphide of arsenic—which could be done by digesting the powdered sulphuret of antimony in strong ammonia. He also objected to the term bismuthum album, the adjective being applicable to all the white compounds of the metal. Of the directions for the purification of chloroform, the lecturer spoke with approval, and dwelt on the importance of leaving the crude product in contact with sulphuric acid but for a short time, and of rectifying with slaked lime as well as chloride of calcium. The faulty process for collodium (which remains unamended in the small edition of the Pharmacopœia), it was explained, was an accidental direction, the author of the process contemplating the use of a weaker nitric acid than that which was at last adopted by the committee. Speaking of emplastrum cantharidis, the lecturer showed how completely the compilers of the Pharmacopœia had ignored, or were unacquainted with, the researches of several experimenters who have proved the advantage of heating the powdered flies for some time with the fatty ingredients. When this is done the cantharidin is dissolved, and every part of the plaster is active. In the directions for the preparation of extracts, it appeared that the suggestions of numerous pharmaceutists who have written on the subject have been attended to, and the processes were, for the most part, approved. The processes for the iron preparations next noticed were also, for the most part, commended; but Dr. Attfield objected to the names of the two oxides as not being explanatory of their composition. The Ferri peroxidum of the Pharmacopœia is, as shown in the formula given, a hydrated oxide; while the Ferri peroxidum hydratum is really a moist hydrated peroxide, or a terhydrated peroxide, when recently precipitated, and becomes the compound indicated by the formula of the Pharmacopœia, $2Fe_2O_3 3HO$, only after being kept some time under water. Ferri sulphas granulata the lecturer believes to be a partially dehydrated sulphate of iron containing six instead of seven atoms of water. The ordinary sulphate would appear, from the experiments of several authors quoted, to have water lodged between the plates of the crystals, which carrying oxygen from the external air, leads to the rapid oxidation of the salt. This mechanically adherent water is removed by the spirit, and hence the granular sulphate oxidises less readily. The proportions of oxide of iron and acid tartrate of potash for the Ferrum tartaratum are those given by Mr. Bastick, and yield a compound quite in accordance with the formula of the Pharmacopœia. The adoption of the names calomel and corrosive sublimate for the well-known mercurial salts Dr. Attfield showed to be an unnecessary innovation, since the atomic constitution of the mercurial salts may be considered to have been finally settled by Dr. Frankland some months before the publication of the Pharmacopœia, and the older names chloride and bichloride of mercury shown to be perfectly correct. The retention of Hydrargyrum cum cretâ was objected to by the lecturer on account of the uncertainty of its action, resulting from the variable proportions of red and black oxide of mercury which may be present. Speaking of the infusions, it was pointed out that the directions for Infusum calumbæ might be improved by ordering the strained product to be heated to boiling in order to effect the coagulation of the albumen, as recommended by Squire and Greenish. The process for Liquor ferri perchloridi Dr. Attfield objected to as the worst which could have been chosen. It gives a mixture of perchloride and pernitrate, for the whole of the nitric acid is not removed by the boiling. It would be better, he thought, to make the tincture from the solid chloride, and the easiest way of obtaining a pure and definite perchloride of iron, he said, was by passing dry chlorine into a mass of warm iron nails contained in a flask. Micaceous crystals of the sesquichloride are at once formed, and may be sublimed into a bottle without difficulty by the application of heat.

Dr. Attfield continued his criticism of the Pharmacopœia on the 20th inst., and we shall proceed with our report next week.

ACADEMY OF SCIENCES.

April 11.

The first paper was by M. Peligot, "*On the Alloys of Silver and Zinc.*" In consequence of the increasing scarcity of silver money in France, which is constantly disappearing from circulating on account of the continued rise in the value of the metal, the French Government is about to lower the standard of the silver coinage by the addition of about 7 per cent. more copper. The new money will be made of an alloy consisting of 835 parts silver and 165 parts copper. M. Peligot is chemist to the French Mint, and he has made experiments to ascertain how the introduction of some zinc or the complete substitution of zinc for the copper would affect the alloy. He has found that alloys of the legal standard in which part or the whole of the copper was replaced by zinc are remarkably malleable, and when rolled are perfectly homogeneous. They are of a beautiful white colour, but the binary alloy of silver and zinc is somewhat yellowish. The fusibility of the zinc alloys is greater than the copper; they are very sonorous and elastic, and if made brittle by hammering the malleability is restored by heating. The study of the atomic alloys showed curious results. Equal equivalents of silver and zinc, or two equivalents of silver to one of zinc, gave malleable alloys, while the compounds $Ag + 2Zn$ and $2Ag + 3Zn$ are too brittle to be rolled. As a matter of economy, the author recommends that his government should employ zinc to reduce the value of the present money, the price of zinc being only one-fifth that of copper. Another recommendation to the zinc alloy is the fact of its blackening less readily with sulphuretted hydrogen than the copper compound, copper, indeed, seeming to increase the discolouration. An alloy of 800 of silver and 200 of zinc will keep its whiteness in a solution of a polysulphide, which will rapidly blacken the legal alloy of copper and silver. This, as the author points out, will be useful information to the makers of jewellery. The absence of verdigris under the action of acid liquors is another advantage. In conclusion, the author mentions a fact of no great importance to us, namely, that the introduction of zinc into money is nothing new. French copper money contains one per cent. of zinc, and the small coins of Switzerland contain zinc, silver, and nickel.

M. Cahours presented another memoir "*On the Respiration of Fruits.*" He has found that if a fruit is placed in either nitrogen or hydrogen it evolves carbonic acid, and the volume of the gas outside is increased. Hence it follows that the carbonic acid must result from changes inside the fruit independent of the external atmosphere. What are the changes? It is a sort of fermentation which goes on, says the author. It is the destruction of the tannoid matters, says M. Chatin, which always takes place as a fruit ripens and rots. [Will any reader make an experiment with some medlars, and settle the question?]

Here M. Fremy steps in with some "*Remarks on the Maturation of Fruits,*" in which he states that he and M. Decaisne settled the whole question some time ago. According to these gentlemen, there are three stages in the existence of a fruit. In the first stage, that of development, the fruit is green, and behaves to the atmosphere like a leaf decomposing carbonic acid in solar light and evolving oxygen. In the second stage, that of ripening, the green colour changes to yellow, brown, or red; the fruit then transforms the oxygen of the air into carbonic acid, which is produced in the cellules of the pericarp in consequence of a series of slow combustions, in which the immediate soluble principles disappear. Tannin goes first, then acids, and afterwards sugar. In the third stage, that of decomposition, the effect of which is the destruction of the pericarp and the liberation of the seed, air enters the cellules, sets up the alcoholic fermentation, and the acids of the fruit give birth to true ethers. Finally, it not only decomposes the cellules, but it oxidises certain immediate principles which have resisted the changes in ripening. Here we find that M. Fremy has anticipated us with the medlars, which, he says, everybody knows are at first very acid and astringent, and only become eatable when they are mellow.

A very interesting paper by the Abbé Laborde was read entitled "*Permanent Stratification Produced by the Induction; New Arrangement of Interrupters.*" By connecting a collodion plate which has been exposed and developed, the author (if too much silver is not reduced, and so the plate made too good a conductor) gets a permanent figure of the stratification of the induction spark. To obviate the disadvantages of the ordinary contact breaker, the author has contrived an arrangement by means of which one end of an oscillating lever is made to dip further into the mercury before it escapes to break the contact, and thus the whole force of the current is obtained. We shall describe this arrangement at length on an early occasion.

M. Naquet replied to M. Kekule "*On the Atomicity of Elements*" (see No. 226, p. 157). He still believes that oxygen, sulphur, selenium, and tellurium are tetra-atomic.

M. Baudrimont communicated a very interesting note "*On Sulphur considered as a Constituent Element of Amber.*" All the specimens of amber which the author experimented upon he found to contain a small proportion of sulphur, which he believes to exist there in combination with organic matter, and therefore to be a natural constituent, and not derived from the materials in which it is found. The succiniferous plants, he thinks, must have contained sulphur, as the cruciferous and alliaceous do now. M. Baudrimont can find no sulphur in copal and Dammar resins.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

April 5, 1864.

E. W. Binney, *F.R.S., F.G.S., President, in the Chair.*

Mr. John Eastham was elected an ordinary member of the Society.

Messrs. H. M. Ormerod and G. C. Lowe were appointed auditors of the society's accounts for the present session.

Mr. Bottomley gave the results of some experiments upon the estimation of sulphur made according to a method devised some time ago by M. Pelouze. This method had been brought under the notice of the society by Dr. Calvert as being a quick and approximate one. The present experimenter had, however, obtained these approximations within such wide limits that he had not found the process available for the purpose intended. In these experiments, 20 grains of the ore, very finely powdered, were mixed with 100 grains of carbonate of soda, 100 grains of chlorate of potash, and 140 grains of common salt. The carbonate of soda and common salt were always heated previous to an experiment, to ensure their being quite dry. These materials were well mixed for about ten minutes in a porcelain mortar. In all cases the mixture quietly deflagrated without throwing any particles out of the platinum crucible. The following were the results obtained :—

	True Percentage.	Percentage by Alkalimetry.
1.	36·98	33·20
2.	40·75	36·95
3.	38·44	38·80
4.	39·64	42·11
5.	36·87	41·70

In the two first experiments the materials were kept fused at a low red heat for some time after deflagration had ceased. In the three last experiments the lamp was removed soon after deflagration had taken place. In the filtrate from the first experiment arseniate of soda was found. In the fourth and fifth experiments arsenic was also found, but not in quantities adequate to account for the difference between the two percentages. These wide differences between the results in the two columns no doubt depend upon the fact that the chlorate of potash does not act merely as an oxidising agent, but gives up some chlorine. In all cases some oxygen compound of chlorine has been evolved with the carbonic acid. It is worthy of remark that many years ago it was stated by Vauquelin that the residue obtained after decomposing chlorate of potash was sensibly alkaline.—(*Ann. de Chimie et de Physique*, xcv., 101.) A few grammes of chlorate of potash were heated in a platinum dish for a few minutes, until the fluid mass began to solidify. This residue dissolved in water gave a solution that seemed faintly alkaline, so faint, however, as to be scarcely perceptible. Prolonged heat and perfect decomposition of perchlorate of potash might perhaps have made it more marked. The above experiments were made in Mr. Spence's laboratory. The same method had been tried in Mr. Rumney's laboratory, by Mr. Bocharoff; his results, however, did not agree with the true percentage. He also ascribed the disagreement to the same cause as that suggested in this notice.

Mr. Baxendell gave the details of some observations he had lately made at Southport to determine the velocities of rifle balls. Three kinds of rifle were used by the firing party—the Whitworth, the Henry, and the Enfield; and the distance of the target being 600 yards, it was found that the average times required by the balls to traverse this distance were :—

	Seconds.
With the Whitworth rifle	1·59
" Henry	1·75
" Enfield	1·87

The velocities were therefore—

	Feet per Second.
With the Whitworth rifle	1132
" Henry	1028
" Enfield	962

The differences between individual results were greatest with the Enfield rifle, and least with the Whitworth; and number of points made was greatly in favour of the Whitworth instrument, the accuracy of fire apparently increasing in a greater ratio than the increase in the velocity of the balls. It was understood that the charges of powder used were those which experience had shown to be best adapted for each form of rifle.

New Method of Colouring Woods.—The surface to be coloured is smeared with a strong solution of permanganate of potash, which is left on a longer or shorter time, according to the shade required. In most cases five minutes suffice. Cherry and pear-tree woods are most easily attacked, but a few experiments will serve to show the most favourable circumstances. The woody fibre decomposes the permanganate, precipitating peroxide of manganese, which is fixed in the fibre by the potash simultaneously set free. When the action is ended, the wood is carefully washed, dried, and afterwards oiled and polished in the ordinary way. The effect of this treatment on many woods is said to be surprising, particularly on cherrywood, to which a very beautiful reddish tone is communicated. The colour is in all cases permanent in light and air. — *Dr. Wiederhold, Neues Gewerb. für Kurhessen*, 1863, s. 194.

NOTICES OF BOOKS.

Journal für Practische Chemie. Nos. 23 and 24. 1863.

The last number of the above Journal received contains a paper by C. Jackson, "*On the Recognition of Alumina by means of Carminic Acid, and the behaviour of Various Carminic Salts to several Re-agents.*" The results obtained by the author in his experiments are curious, but not perhaps sufficiently characteristic to be made useful. He considers that a carmine paper prepared by colouring with cochineal tincture, Swedish filtering paper, already acidulated with acetic or hydrochloric acid, may be used to detect alumina in minute quantity in either neutral, acid, or alkaline solutions. The acidulated paper is orange or flesh coloured, but after contact with alumina it becomes when dry of a carmine red colour. Von Bibre gives an elaborate paper "*On the Chemical Ingredients of some Limestones.*" The limestones experimented upon were all found in Germany. Rochleder has an interesting communication "*On the Crystalline Ingredients of the Bark of the Horse-chesnut Tree.* The author gives an account of fraxin, æsculin, æsculetin, and another body obtained in very small quantity, having the composition $C_{24}H_{15}O_{30}$, together with an account of their chemical properties. A paper "*On Morin and Morintannic Acid,*" by Hlasiwetz and Pfaundler follows. The name, morintannic acid, the authors think inapplicable to the substance, which possesses no acid properties; they therefore propose *Maclurin* from *Macluria tinctoria*, the botanical name of the fustic tree. The so-called morintannic acid, when treated with hot caustic alkali, they find splits up into an acid and phloroglucin. The acid appears to be identical with the protocatechuic acid of Strecker, the carbo-hydrocinchonic acid of Hesse, and the oxy-salicylic acid of Lautemann. The same authors have also a communication "*On Quercitrin Sugar,*" which they state to be isomeric with mannite and melampyrin. It forms a weakly explosive nitro-compound. The *Notizen* contain but little which has not already appeared in the Chemical News.

Poggendorff's Annalen der Physik und der Chemie. No. 3, 1864.

This Journal opens with an elaborate paper by Rammelsberg, *On the Sulphur Compounds of Iron, the Composition of Magnetic Pyrites, and the Occurrence of Sulphuret of Iron in Meteoric Iron.* The author endeavours to answer the following questions:—What is the composition of the products obtained by heating iron and sulphur or oxide of iron and sulphur at high and low temperatures? What compound remains behind after heating iron pyrites? Are iron sulphuret (FeS) and magnetic pyrites formed in the same way at different temperatures? A short paper, *On Meteoric Sulphide of Iron*, by the same author, follows, and is succeeded by another, giving *the specific gravities of several compounds of iron and sulphur.* Brodie's paper, *On the Peroxides of the Radicals of Organic Acids*, comes next. Müttrich's learned paper, *On the Optical Properties of Crystals, and of Rape Oil and Distilled Water at different Temperatures*, is concluded. A communication by A. Mitscherlich, *On the Spectra of Simple and Compound Bodies*, and some *Researches on Electrical Appearances*, by F. C. Henrici, follow, and the number concludes with a short paper, *On the Condition of the Sun*, by Magnus, in which he mentions some interesting experiments on the influence of soda, solid and in vapour, on the radiation of heat.

Zeitschrift für Chemie und Pharmacie, &c. Heft 7. 1864.

In the last Number of the above journal, Griess announces the discovery of a new series of organic acids, obtained by treating nitrobenzoic acid with the hydrate of potash. Hlasiwetz and Gilm have procured two new acids by treating berberin with the same reagent. The same authors have obtained two new bodies by carefully fusing guaiacum resin with caustic potash. The first is a crystalline acid, and the second an amorphous body, which also appears to be an acid. From galbanum resin, Hlasiwetz and Barth have, by similar treatment, procured a new body homologous with Orcin, and possessing nearly all the properties of that body. Drs. Erlenmeyer and Hoster announce the discovery of oxalic and glycollic acids in the juice of unripe grapes. This is an important discovery in connexion with vegetable physiology and chemistry.

The British Pharmacopœia. Smaller Edition.

We need only announce the issue of this edition, which the profession has waited for very patiently for some months. There are, of course, no substantial alterations from the larger book. One or two obviously clerical errors in the manuscript have been corrected; and the directions for the preparation of hydrochloric acid have been amended by ordering the application of heat; but with these exceptions the contents of the two books are identical. It would have been impossible, we presume, to make any important changes in the book, and the Pharmacopœia must remain as it is, we suppose, for the next ten years, unless the Medical Council candidly admit the failure, and proceed at once to a complete revision, which report says is about to be done.

A Treatise on Pharmacy; designed as a Text-book for the Student, and as a Guide for the Physician and Pharmaceutist, &c., &c. By Edward Parrish. Third Edition. Philadelphia: Blanchard and Lea. 1864.

For the present we must content ourselves with merely noticing the arrival of this book. We have had occasion to speak very highly of former editions, and in this we find large additions of important matter, rendered necessary by the recent publication of the United States' Pharmacopœia, which greatly increases the value of the work.

We shall notice the book at greater length very shortly.

The Preparation and Mounting of Microscopical Objects. By Thomas Davies. London: Hardwicke. 1864.

This is a really useful and, moreover, a very cheap book, which we can confidently recommend to all beginning the use of the microscope. Practised hands will also find many original and valuable hints and directions scattered about its pages.

NOTICES OF PATENTS.

2909. *Manufacture of Zinc Oxide.* G. Darlington, Minera, Denbigh. Dated October 29, 1862.

The preparation of white oxide of zinc for paint, &c., is conducted on the principle of using a smokeless carbonaceous fuel (anthracite or charcoal) in combination with the zinc ores, and leading the zinc fumes from the reduction furnace into an adjoining condensing-chamber freely supplied with atmospheric oxygen. The quality of the product is said to be remarkably good, especially as regards purity of colour.

2913. *Treatment of Copper Ores.* W. Clark, Chancery Lane, London. A communication. Dated October 29, 1862.

For the more ready extraction of metallic copper from the fused regulus, and sulphuretted ores or products of that metal, the inventor directs a blast of air, with or without steam, into the furnace in which the reduction is being effected.

5937. *Carburetting or Naphthalising Gas.* W. R. Bowditch, Wakefield. Dated October 31, 1862.

The patentee describes and gives drawings of an apparatus intended to be employed in increasing the illuminating power of coal gas. The use of volatile hydrocarbons is resorted to, and heat applied as a means of augmenting the light-producing power of these fluids.

2982. *Dyeing.* P. W. Reuter, Buckland Crescent, St. John's Wood. A communication. Dated November 4, 1862.

The essence of this invention consists in the use of compound solution as a preparative in the dyeing of wool. The liquor is made by boiling together oxide of lead, carbonate of soda, and milk of lime, and the wool is treated at once with this solution at about 180° Fahr., or with the previous addition thereto of the colouring matters. Wool thus dyed is then passed through the soap bath, and finally washed in very dilute hydrochloric acid for the purpose of removing every trace of these alkaline matters, and at the same time brightening the colour.

3157. *Deodorising Mineral Oils and Hydrocarbons.* J. Moule, Hackney Road. Dated November 25, 1862.

For the disinfection of crude petroleum and rock oils, the inventor treats them with nitrous acid or with gaseous binoxide of nitrogen, either of which agents will entirely remove the disagreeable odour appertaining to the crude oils of this class. The products from coal-tar naphtha and paraffine oil may likewise be treated in this manner.

Grants of Provisional Protection for Six Months.

292. Henry Edwin Drayson, Southampton, "An improvement in the manufacture of gunpowder."—Petition recorded February 4, 1864.

497. Frederick Weil, Paris, "Improvements in coating metals with one or several other metals, and in oxydising the surface of these latter."

503. Joseph Wilson Swan, Gateshead, Durham, "Improvements in photography."—Petitions recorded February 29, 1864.

519. William Millar, High-street, Hull, Yorkshire, "Improvements in the manufacture of sugar, and in the apparatus employed therein."—Petition recorded March 2, 1864.

542. William Ibotson, Wraysbury, Middlesex, "Improvements in the manufacture of paper, and in machinery employed therein."—Petitions recorded March 3, 1864.

552. Alexandre Manbre, Baker Street, Portman Square, London, "Improvements in the manufacture of glucose sugar."—Petitions recorded March 4, 1864.

556. Henry Cochrane, Ormesby Ironworks, Middlesborough-on-Tees, Yorkshire, "Improvements in moulds for casting metals."

562. Charles Humfrey, Suffolk Grove, Southwark, Surrey, "Improvements in vulcanising india-rubber."—Petitions recorded March 5, 1864.

568. William Edward Newton, Chancery Lane, London, "Improvements in refining sugar and molasses."—A communication from Louis Pierre Robert de Massy and Louis Robert de Massy, Rue St. Sébastien, Paris.—Petitions recorded March 7, 1864.

580. William Edward Newton, Chancery Lane, London, "Improvements in the manufacture or production of baryta and strontia."—A communication from Louis Pierre Robert de Massy and Louis Robert de Massy, Rue St. Sébastien, Paris.—Petitions recorded March 8, 1864.

582. Frederick Tolhausen, Boulevart Magenta, Paris, "Improvements in the manufacture of washing blues."—A communication from Madame Jobert, Dôle, France.

584. James Preston Worrall, Ordsall, Lancashire, "Certain improvements in dyeing or colouring looped cut pile or raised textile fabrics composed of cotton and silk."

586. George Davies, Serle Street, Lincoln's Inn, London, "Improved means of transforming the ebb and flow of the tide into a continuous and constant hydraulic power."—A communication from François Alfred Tallendeau, Nantes, France.

588. Felix Spiers and Christopher Pond, Princes Street, Cavendish Square, London, "Improvements in closing or stoppering bottles."—A communication from Barlow William Mallam, Melbourne, Victoria.

592. Edward Bishop, Headingly, near Leeds, and William Baily, Halifax, Yorkshire, "Improved means and apparatus for evaporating the water contained in fœcal or excrementitious matter."

594. Nathan Thomson, Abbey Gardens, St. John's Wood, Middlesex, "Improvements in apparatus for stopping bottles, jars, and other vessels, which improvements are also applicable to stopping the muzzles of fire-arms."

595. James Lee Norton, Belle Sauvage Yard, Ludgate Hill, London, "Improvements in the manufacture of manure, and in machinery to be used in this manufacture."

Notices to Proceed.

2903. John Kirkham, Euston Road, London, "Improvements in the treatment of certain ores of iron."

2913. James Seward, Clitheroe, and Henry Smith, Enfield, Lancashire, "An improved apparatus for preventing incrustation in steam boilers."

2931. Ferrar Fenton, Camberwell, Surrey, "Improvements in the treatment of vegetable fibres for the production of paper pulp or half stuff therefrom."

2949. George Wagstaff Yapp, Clement's Inn, Westminster, "Improvements in the preservation of animal substances."—A communication from Edward Gorges, Croisie, France.

2974. James Baker, Temple Street, Whitefriars, London, "Improvements in compositions applicable to the coating of ships' bottoms.

2981. Frederick Page, Birmingham, "Improvements in furnaces and apparatus for the manufacture of volatile hydro-carbons, which improvements are also in part applicable to furnaces and apparatus for the manufacture of illuminating gas."

2998. Samuel Smith and Thomas Smith, Fell Street, London, "Improvements in composition or means for the purpose of destroying insects by fumigation, and in means or apparatus employed therewith."—Petitions recorded November 27, 1863.

3009. Benjamin Jones, Warrington, Lancashire, "Improvements in separating sulphur from alkali waste."

387. Peter Armand Lecomte de Fontainemoreau, South Street, Finsbury, London, "Certain improvements in the manufacture of methylic ether and its application to the production of artificial ice."—A communication from Charles Tallier, Passy, near Paris.—Petition recorded February 15, 1864.

Do Vegetables Respire?—The subject of vegetable physiology is very interesting, but intricate, many observers having given a great amount of time to the prosecution of inquiries in this branch of science, and much still remaining to be investigated. M. Mène, who has devoted his attention to the respiration of vegetables, has arrived at the following conclusions:—A plant can grow and flourish without taking in carbonic acid by its leaves. During the day time the plant does not evolve carbonic acid, nor take up all the carbonic acid, of the air in which it is placed. During the night and foggy days no absorption of carbonic acid takes place by the leaves. The amount of moisture transpired by the leaves depends more on the light than on the temperature. The carbonic acid set free from the leaves is the result of an elaboration by the roots. The amount of carbonic acid set free during the night is in proportion to the activity of vegetative life during the day. The great evaporation from the leaves seems to quite overthrow the idea of a vegetable respiration, that is, of an absorption of gas by the leaves, if the roots are acting normally.

CORRESPONDENCE.

Continental Science.

PARIS, April 19.

AT the scientific meeting of the Sorbonne, held on the 7th of this month, M. Pasteur treated of the subject of spontaneous generation. This conference is considered the grand triumph of the season. The importance of the subject in its bearing on other questions, such as that of the existence of the Deity, the eternal duration of matter, &c., was pointed out by the learned professor, who then put forth the various arguments in favour of and against the doctrine, showing the objections in a forcible manner, and altogether treating the subject with a masterly hand.

The following distribution of medals was made on the 10th of April at the Imperial and Central Society of Agriculture, his Excellence the Minister of Agriculture, &c., being in the chair:—Great medal of gold to A. M. and Madame Courade de Witt, for works on agricultural improvements effected on their domain; to M. Reiset, for works on agricultural improvements; to M. le Varonde Vaunce, for works on improvements in drainage and irrigation performed on the domains of Belleau; to M. Scipio Gras, for his geological and agricultural map of the department of L'Isère. Medal of gold to A. M. Maillebeau, to Dr. Jules Guyot, to M. Henrion Barhezant, to M. J. Beandouin, to M. Martin de Lignac, to M. Pichon, to M. Trépagne, to M. Théron de Montaugé, to M. Bataillard. Medal of silver to A. M. Théac.

The frequent occurrence of internal parasites in Algeria is noticed in *La Gazette Médicale* as having been observed by Dr. Baiseau. Soldiers are very apt to be attacked by these animals through drinking water which has not been filtered, and great difficulty is experienced in eradicating them. Vinegar and water or salt and water has been sometimes found successful, but it sometimes requires a long time before the animals can be dislodged.

At the Academy of Sciences of Vienna for the 17th March, a memoir was presented by M. Unger "*On a Species of Fossil Fern occurring very frequently in the Tertiary Strata.*" Portions both of the leaves and of the roots have been found.

M. Seligman made a verbal report on the skulls of different human races, which had been sent to him from Valparaiso by Dr. Aquinas Ried.

A bust of Dagnerre of the natural size has been presented to the French Society of Photography. The bust was executed from photographs. M. Liebert placed before the Society enlarged prints obtained by means of the apparatus described at the previous meeting. M. Sabatier Biot described a new improvement which he has recently effected, in the construction of a chamber for operating in the country. He says the improvement consists principally in a regulator placed on the upper part of the frame for carrying the glass.

M. Morvan placed before the Society prints obtained by the process of which he has given the description. Several other gentlemen also exhibited prints by various processes. M. Delmas presented to the Society a seconds clock constructed by him for the use of photographers. In the bulletin of the Society there is also a note on the process of printing with ink from photographic images. The image is obtained by spreading a gelatinous or gummy film, containing bichromate of potash, on paper and placing it behind a negative. The light developes the drawing with change of colour. The print is then placed on the surface of water with the prepared side upward, the water soaks through the paper, and the parts unacted on become wet, while those coagulated by the light resist the passage of the water. The print is then pressed on a lithographic stone, which is moistened in those parts where the water has penetrated; the stone is then inked, and the remainder of the process conducted as usual. There is also a notice of recent modifications in the tannin process.

On Double Salts.

To the Editor of the CHEMICAL NEWS.

SIR,—A question has recently been raised among photographers as to the existence of the double chloride of gold and sodium. The objection put forth is a statement occurring in Fownes' "Chemistry," Ed. ix., p. 266, that double salts are never formed from bases taken from the same isomorphous family, and it is asserted that gold and sodium are isomorphous. The existence, however, of a double hyposulphite of gold and sodium would seem to be analogous in constitution to a double sulphide, one compound acting as acid and the other as base; or we may consider that hydrochloric acid under the joint influence of gold and sodium becomes polybasic, or that chloride of gold and hydrochloric acid combine together to form a compound acid $HAuCl_4$, in which the hydrogen can be replaced by other metals. There is no doubt as to the existence of the double salt, for it can be obtained in definite crystals, and the double salts of gold with organic bases are often employed to determine their equivalents, so that there is no doubt about their definite nature, and it does not at all follow that because chloride of sodium is sometimes found in excess in the commercial dry salt, or that because on solution in water common salt is left behind, there is no real combination, for it is possible that a double salt might be decomposed by water. There seems to be a regular gradation in the properties of these double salts, some of them approaching to the nature of salts of polybasic acids or of salts of compound acids, such as $HAuCl_4$, while others seem to be loose combinations of the two salts, which are held together by an attraction resembling that which holds the water of crystallisation to a salt, and between these two extremes there are intermediate stages. In fact, we may in some cases imagine a polybasic acid to be only polybasic when different bases are neutralised by it, the different bases causing the acid to assume a polybasic character, just as we may suppose gold and sodium to give to hydrochloric acid a polybasic character; for instance, employing the old equivalents and notation, there would be nothing inconsistent in the statement that in alum sulphuric acid is a quadribasic acid, the change being induced by the presence of the two bases; nor, on the other hand, in supposing tartaric acid to be monobasic, except when neutralised by two different bases. Such salts, however, as the double sulphates of iron and potash are at the other extremity of the series, these being apparently loose combinations of the two salts; while the gold salts are intermediate. The supposition in this case of a compound acid containing gold being formed is borne out by the analogy with the sulphur acids and salts; in fact, we should anticipate that there would be compounds intermediate in properties between bibasic and monobasic acids, no abrupt transitions being made in nature, and the bodies we have been considering supply this link.

There are reasons why bases from the same isomorphous group should not have a tendency to form double salts, for the isomorphous elements, being similar in properties in this respect, both want to occupy the same place in the compound; it is opposition of properties that tends to make a strong combination; and also, supposing a double salt to be formed, since one isomorphous element can replace another in a compound, the body might appear to have an indefinite composition. In the case of the double salts approaching polybasic acids in their character, it might still be that isomorphous bases were less likely to produce such compounds, for bodies not isomorphous might offer greater inducement to the acid to assume a polybasic character.

I am, &c. A. C. S.

March 30.

Radicle v. *Radical.*

To the Editor of the CHEMICAL NEWS.

SIR,—As you have allowed your correspondent "C. W. Q." to say a few words on the *radiculous* side of the dispute to which you have opened in your columns, perhaps you will be kind enough to grant me a short space for a reply.

If I do not mistake, it was Berzelius who first used the word *radical* to express what your correspondent and some others think is better expressed by *radicle*. Berzelius has been followed in the use of the word by most of the chemists since his time, by Gerhardt, by Laurent, not to mention living men, every one of whom, I imagine, was perfectly well acquainted with the French equivalent of *radicle*, and no doubt would have employed it if he had considered the word more appropriate. But is a diminutive a proper term to apply, say to cyanogen? Your correspondent says that cyanogen is the "little root" of the cyanogen compounds, which looks ridiculous. If radical be substituted by any other word, it should certainly be "root." I can imagine cyanogen the root of the cyanogen compounds, but cannot conceive of it as the "little root." But what advantage would there be in any alteration? The word radical is now perfectly well understood; its use has been consecrated by Time and great names, and why should we adopt any other term? If the innovators can give us any good reason for the change I shall be happy to follow them, but in the meantime I beg to subscribe myself yours, &c. A RADICAL.

MISCELLANEOUS.

Chemical Society.—Mr. Bassett requests us to state that the title of his paper read at the last meeting of the Chemical Society (see page 184) should have been "*On the Tetra-Basic Carbonate of Ethyl.*"

Radcliffe Travelling Fellowship, Oxford.—The Radcliffe Travelling Fellowship has been awarded to A. B. Northcote, B.A., of Queen's College. Mr. Northcote took a first-class in Natural Science in March Term, 1861.

Accidental Poisoning.—A lamentable occurrence happened in Liverpool a few days ago from the accidental substitution of strychnia for James' Powder. This could only have happened from the dangerous practice of keeping precipitated instead of crystallised strychnia in stock—dangerous for two reasons, the liability of the strychnia to adulteration, and the possibility of a substitution like that which was made.

A Davy Memorial.—A committee of the working men of Penzance having raised 500*l.* towards a memorial of the late Sir Humphry Davy, two ladies of that town—whose kindness to the poor is only equalled by their discriminating gifts—have offered to contribute 1000*l.*, on the sole condition that the memorial shall take the form of almshouses. Wednesday's *Cornish Telegraph* announces a further donation of 100*l.* by Mr. T. H. Bodilly, a merchant, of Penzance, and the proffered assistance of the London Chemical Society in securing for his natal place a memento of the distinguished chemist.—[We have authority for stating that this announcement, so far as regards the Chemical Society, is premature.]

Address to Convocation.—An address to Convocation is in course of signature among students of the natural sciences, which expresses a sincere regret that researches into scientific truth are perverted by some in our own times into occasion for casting doubt upon the "Truth and Authenticity of the Holy Scriptures." The following sentence, with which it concludes, expresses the object of the address:—"We therefore pray that the Bishops and Clergy in Convocation assembled, and of the Church of England, will do all in their power to maintain a harmonious alliance between Physical Science and Revealed Religion."

Black Dye for Kid Gloves.—Dissolve ten kil. of red chromate of potash in a sufficient quantity of hot water, and gradually add potash until the liquid no longer reddens litmus; then spread with a sponge, as a dye, this solution of chromate of potash on the skin. Besides this, there should be prepared, in a copper cauldron, a dye composed of one kil. of rasped fustic, ·750 kil. of fustic, one kil. of ground logwood, and three pailfuls of water; after being clarified this should be briskly boiled till there remains only two pailfuls of liquid, the rest being evaporated or absorbed by the wood. This dye is applied to the skin somewhat dried and mordanted with chromate of potash. The skin should be spread out on a table and left till it attains the proper medium of dryness. It is then coated with a solution of one kil. of Marseilles soap, thick enough to form a kind of jelly, with which is mixed ·750 kil. of very pure colza oil, which should be so well incorporated as to have no drop of oil visible. This soap jelly frees the dyed skin from all humidity, and renders it supple, soft, and lustrous.—*Moniteur Scientifique*, v. 847.

Salicin in the Urine.—Dr. Landeren has found that when salicin is administered in considerable doses it passes away in the urine unchanged, and can be easily separated from the evaporated urine by means of alcohol. —(*Archiv. der Pharm.*, bd. c. xvi., s. 197.)

New Sounding Apparatus.—A new maritime sounding apparatus has recently been invented by M. Gollezel. A great objection to that at present employed is that currents in the water cause the line of suspension to be bent, and so the apparent depth, judged of by the length of line employed, is much greater than the real depth. The purpose to which the new sounder is intended to be applied is for the construction of a chart of the bottom of the ocean, which would be of immense service in the laying of telegraphic cables, and, apart from such uses, the possession of such a map would be of great scientific interest. In the improved apparatus the suspension line is altogether dispensed with; a rod of iron, furnished with nippers at the extremity, supports a cylindrical weight capable of being detached from the rod; above the weight a float of hollow metal is fixed. On striking the bottom of the water the weight is detached, and the remainder floats to the surface; a small clock enclosed in the apparatus is so arranged as to stop by the concussion, so that the time of descent can be estimated; a bell is also attached; an easily visible object is fixed above the whole, to avoid any difficulty in finding the apparatus after its arrival at the surface. The advantages of this apparatus for the purposes to which it is destined are so apparent that comment is unnecessary; close approximation to the real depth of the water at various parts of the ocean, with much more rapidity than with the old method, will now be obtainable, the friction of the line in the water retarding the descent to an immense extent.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements* and *Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

E. B.—It would take a page of the CHEMICAL NEWS to give you the details you ask. Refer to the last edition of Fresenius, p. 465.

W. G. S. W.—1. You are adopting the best method of purifying the naphtha. Distil from the brown deposit. 2. By dissolving hydrated alumina in hydro-fluoric acid, and evaporating the solution. The evaporation must be carried on in a metal dish. 3. We cannot advise. A chemist has sometimes great opportunities, but has often to submit to great disappointments.

M. S. C. E.—You will have to pass an examination in prescriptions, chemistry, materia medica, and pharmacy. The secretary, Mr. Brembridge, will give you all necessary information.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Thallium-iron-Alum, by WILLIAM CROOKES, *F.R.S., and Professor* A. H. CHURCH, *M.A.*

THIS salt was prepared and analysed nearly twelve months ago, and some crystals of it were then sent to Professor W. H. Miller, of Cambridge, for optical examination. Circumstances prevented the crystallographic characters of the salt coming to hand till recently, and, in the meantime, M. Nicklès* has published a brief account of the same salt.

Thallium-iron-alum readily crystallizes out when a solution of its component salts is evaporated. It forms large transparent crystals, having a faint amethystine colour, tolerably soluble in water, and fusible below 212° F.

The sulphuric acid was determined by dissolving in water, adding dilute nitric acid, and precipitating with nitrate of baryta. The iron was determined by precipitation with ammonia; and the water, by drying in an air bath above 212°. The thallium was estimated by dissolving in a small quantity of hot water, adding an excess of strong hydrochloric acid, filtering, and washing, first with water, then with dilute alcohol.

9·4289 grains of substance gave 6·6435 grains of $BaO.SO_3$.

16·2802 grains of substance gave 1·9521 grains of Fe_2O_3.

8·2870 grains lost 2·6543 grains of HO.

17·6530 grains gave 6·2197 grains of TlCl.

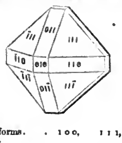
From these figures the following percentages are calculated :—

	Theory.	Experiment.
Tl	30·435	29·989
Fe_2O_3	11·994	11·991
SO_3	23·988	24·173
HO	32·384	~~33·147~~ 32,047

Leading to the formula—

$$TlO.SO_3.Fe_2O_3.3SO_3,24HO.$$

We are indebted to the kindness of Professor W. H. Miller for the following observations regarding the crystalline form, &c., of the thallium-iron-alum :—



"Cubic.

Observed forms. . 100, 111, 110.

Angles :—

$111, \bar{1}11$ . . . 70° 32′

$111, 010$ . . . 54° 44′

$111, 110$ . . . 35° 16′

$\bar{1}11, 11\bar{1}$ . . . 109° 28′

$010, 110$ . . . 45° 0′

$110, 011$ . . . 60° 0′

"Cleavage :—1 1 1, distinct, but not very easily obtained.

"Index of refraction for the brightest rays of the solar spectrum = 1·469."

Perbromic Acid, by M. KAEMMERER.

PERBROMIC acid has been fruitlessly investigated by many chemists, but M. Kaemmerer has obtained it in the most simple manner by treating perchloric acid by bromine; chlorine is disengaged; the remaining liquid may be concentrated without danger in a water-bath to an oily consistence. In this state it is unalterable by sulphurous, hydrosulphuric, or hydrochloric acids, resembling in this respect its congeners, perchloric and per-iodic acids.

Perbromate of potash is more soluble than the perchlorate, and less so than the bromate.

Perbromate of baryta is a crystalline precipitate, very little soluble even in boiling water; it is the same with salt of lead; that of silver, on the contrary, dissolves abundantly in warm water; on cooling, it separates in strongly refracting needles.

The author suspects the new acid exists in the product of the distillation of bromic acid.—*Journ. für Prakt. Chemie*, xc., 190.

TECHNICAL CHEMISTRY.

A Method for Preserving the Colouring Matter of Litmus, by Dr. VOGEL.

IT is well known that litmus tincture so frequently used in analytical researches, alters progressively, even in a closed vessel, and losing its blue colour becomes yellowish brown. That this change of tint is the result, not of the destruction of the colouring matter, but of simple deoxidation, is shown by shaking the tincture in contact with the air, when the blue colour will reappear. Litmus dye, as M. Mohr has remarked, may be conveniently preserved in open, partly-empty flasks, the mouths being lightly plugged with cotton, simply to exclude dust. The author has found, nevertheless, that litmus dye, especially in a slightly concentrated solution, becomes, after a time, turbid and reddish. The latter phenomenon is probably due to the carbonic acid of the air, for on being boiled the liquid resumes its blue colour. M. Vogel now uses litmus dye made immediately before each experiment, with some litmus which he has found a means of preserving unaltered, and which be dissolves in water.

The preparation of this litmus is very simple. Take 16 grammes of commercial litmus, reduce it to a fine powder and put it into a cylindrical glass phial, with 120 cube centimetres of cold distilled water, and leave for twenty-four hours, taking care to stir occasionally. As the first portion of the liquid extract will contain all the free alkali of the litmus, it should be set aside, and on the residue should be poured a fresh quantity of 120 centimetres of distilled water; it should then again be left for twenty-four hours, and shaken at intervals. Then decant a second time, and divide the liquid into two equal parts, and stir one part with a glass tube dipped in diluted nitric acid, repeating the addition of this acid, by means of the tube, until the liquid becomes perfectly red. Then mix it with the other portion which has remained blue. The result is a reddish-blue liquid. A litmus dye is thus obtained as neutral as possible, which must then be evaporated in a porcelain capsule, placed in a sand-bath, and kept below boiling-point. There remains a granular, amorphous mass, which must be kept in a well-stoppered bottle. This matter dissolves in water, leaving no residue, and gives a lighter or darker blue according to the quantity of water used, and has the advantage of furnishing a litmus dye at a moment's notice, and at any degree of concentration which may be required. If, for instance, it is desired to experiment with a standard solution, a piece of the above extract, about the size of a pin's head, put in a wine-glass containing a little water will yield a very convenient solution. This extract may be preserved in closed vessels for years without losing either its solubility or its blue colour.—*Journal de Pharmacie et de Chemie,* xlv. 70. 64.

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* *Journ. de Pharm. et de Chim.*, xlv., 24, 140.

PHARMACY, TOXICOLOGY, &c.

Case of Poisoning by Phosphorus.

The following is the chemical evidence in a case of poisoning by phosphorus. The viscera were taken to Dr. Herapath twenty days after the death of the infant, which had been buried for nearly that time. The history of the case and symptoms led to the suspicion of poisoning by phosphorus. Dr. W. B. Herapath detailed the chemical examination of the viscera, &c., which was as follows:—

"First, they were seriatim removed with great care on clean porcelain vessels to the interior of a photographic camera, and examined in the dark for evidence of luminosity. None presented itself, however, and the contents of the viscera were equally devoid of any such appearances. 2nd. The contents of the stomach were treated with pure ether. The etherial fluid decanted and filtered reduced the salts of gold and silver in such manner as a very minute trace of free or inflammable phosphorus would produce. The residual acid fluid was next tested by Mitscherlich's plan, by distillation with sulphuric acid, but without any corroborative evidence of the presence of phosphorus. 3rd. The same acid fluid was now tested by Scherer's distillation with zinc, and the evolved gas, chiefly hydrogen, passed through ammoniacal nitrate of silver; a black precipitate resulted, too minute in quantity to further test for phosphorus. This gave doubtful evidence of phosphorus existing as phosphorous acid in the contents of the stomach. 4th. The examination of the stomach's contents gave indications of phosphorus in the free state by the ether test, and probable evidence of phosphorous acid by Scherer's mode of testing for phosphuretted hydrogen. 5th. The whole intestines having been slit up for examination, the contents of the large intestine were carefully collected, amounting to two drachms of yellow pasty fæcal matter. This was first tested by Mitscherlich's process, but no evidence of phosphorus in the free condition resulted. The acid fluid produced was then tested by Scherer's process, as before, for phosphorus in the oxidised form of phosphorous acid; and the resulting black precipitate oxidised by nitric acid, and tested by a magnesian salt and ammonia. The characteristic crystals of phosphate of ammonia and magnesia were obtained, which proved the existence of phosphide of silver in the black precipitate, which probably arose from the presence of phosphorous acid in the contents of the rectum, cæcum, and colon in small quantity. 6th. The contents of the small intestines were also removed carefully and tested in the same way. Similar results were obtained, viz., the absence of free or combustible phosphorus, but the presence of phosphorous acid. 7th. One portion of the contents of the duodenum was tested by the tincture of iodine, for the presence of starch, but no blue reaction exhibited itself; whereas a reddish port wine colour was exhibited, which appeared to be due to the presence of dextrine, a substance into which starch is converted by digestion. 8th. In another portion of the contents of the small intestines, I endeavoured to destroy the organic matter of the fæces by nitric acid, and expected to find the Prussian blue, colouring matter, but failed in obtaining any. 9th. The whole of the stomach, small and large intestines, were dissolved in the dark by means of hydrochloric acid, absolutely pure; but no luminous appearances were exhibited: these phenomena would have been observed if a certain proportion of inflammable phosphorus had been present; it is a test nearly as good as Mitscherlich's. 10th. The acid solution, filtered from undissolved matters, were tested in a gas evolution bottle and with certain apparatus attached, which enabled me to test at one operation for arseniuretted hydrogen, antimoniuretted hydrogen, sulphuretted and phosphuretted hydrogen. There was negative evidence of the three former gases, but the black precipitate resulting was proved to be phosphide of silver, and therefore demonstrated the existence of an appreciable quantity of oxidised phosphorus existing in the tissues of the viscera as phosphorous acid; the same product as exists after the phosphorus paste has been exposed to the air. 11th. A large portion of the liver was dissolved and treated in a similar manner, by which a further quantity of phosphide of silver was obtained, from which crystals of phosphate, ammonia, and magnesia were obtained, and examined by the microscope. Results: Evidence of the presence of free phosphorus in minute quantity was obtained from the contents of the stomach; whilst evidence of phosphorous acid, the lower oxide of phosphorus, was obtained by Scherer's test, as modified by myself, from the contents of the stomach, and of the large and small intestines; whilst a still larger quantity of the same phosphorous acid was shown to have been absorbed or imbibed by the tissues of the stomach and intestines, and to be present in the liver; whilst the presence of dextrine in the intestinal canal shows that starch had been present there during life. I infer that phosphorus was probably the cause of the acute inflammation of the mucous surface of the stomach and intestines, of which the infant died."

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.

Thursday, April 21, 1864.

Major-General Sabine, *President, in the Chair.*

Professor H. J. Smith read a paper "*On the Orders and Genera of Quadratic Forms containing more than three Indeterminates.*"

A paper, by Professor F. A. Abel, F.R.S., "*On some Phenomena exhibited by Gun-cotton and Gunpowder under Special Conditions of Exposure to Heat,*" was then read. Being anxious to possess some rapid method of testing the uniformity of products obtained by carrying out General von Lenk's system of manufacture of gun-cotton, the author instituted experiments for the purpose of ascertaining whether, by igniting equal weights of gun-cotton of the same composition, by voltaic agency within a partially exhausted vessel connected with a barometric tube, he could rely upon obtaining a uniform depression of the mercurial column in different experiments made in atmospheres of uniform rarefaction; and whether slight differences in the composition of the gun-cotton would be indicated with sufficient accuracy by a corresponding difference in the volume of gas disengaged, or in the depression of the mercury. He found that, provided the mechanical condition of the gun-cotton, and its position with reference to the source of heat, were in all instances the same, the indications furnished by these experiments were sufficiently accurate for practical purposes. Each experiment was made with fifteen grains of gun-cotton, which were wrapped compactly round the platinum wire; the apparatus was exhausted until the column of mercury was raised to a height varying from 29 inches to 29·5 inches. The flash which accompanied the deflagration of the gun-cotton was apparently similar to that observed upon its ignition in open air; but it was noticed that an interval of time always occurred between the first application of heat (or incandescence of the wire) and the flashing of the gun-cotton, and that during this interval there was a very perceptible fall of the column of mercury. On several occasions, when the gun-cotton, in the form of "roving," or loosely-twisted strand, was only laid over the wire, so that it hung down on either side, the red-hot wire simply cut it into two pieces, which fell to the bottom of exhausted vessel without continuing to burn. As these results appeared to indicate that the effects of heat upon gun-cotton in a highly-rarified atmosphere differed importantly from those observed under ordinary circumstances, or in a very imperfect vacuum, a series of experiments, under variously modified conditions, was instituted, of which the following are some of the most important:—

About fifty different experiments were made with equal quantities of gun-cotton (0·2 grain), placed always in the same position, so that the platinum wire rested upon the material. A tolerably definite limit of the degree of rarefaction was arrived at, within which the gun-cotton was exploded instantaneously, as in the open air. When the pressure of air in the apparatus was reduced to 8·2 in inches of mercury, the gun-cotton still exploded with a flash, but not quite instantaneously; on reducing the pressure to eight inches, the cotton underwent a slow kind of combustion, attended with little or no flame, in the majority of cases; on a few occasions it exploded with a flash of flame. The same occurred in a succession of experiments, until the pressure was reduced gradually to 7·7 inches, when instances of the rapid explosion of gun-cotton were no longer obtained.

Although these results were moderately definite, when the conditions of the experiments were as nearly as possible uniform, it was found that they could be altered by slight modifications of any one particular condition (such as the quantity of gun-cotton, its mechanical condition, its position with reference to the source of heat, the quantity of heat applied, and the duration of its application).

For example, in one experiment the mass of cotton, exposed at one time to heat, was increased by doubling a piece of the twist (four inches long) and laying it thus doubled across the wire, as before. The current was allowed to pass until the wire was heated just sufficiently to ignite the gun-cotton, and then interrupted. In this case the slow combustion proceeded throughout the entire mass of the cotton. The permanent depression of mercury in this experiment was 0·6 inch. It was particularly noticed on this occasion that, as the decomposition of the gun-cotton crept slowly along the mass, the burning portions or extremities of twist were surrounded by a beautiful green light, more like a phosphorescence than a flame, and in form something similar to the brush of an electric discharge.

The various modifications in the nature and extent of combustion which gun-cotton may be made to undergo, as demonstrated by the above experiments, when exposed to heat in highly-rarefied atmospheres under variously modified conditions, are evidently due to the same causes which affect the rate of combustion of fuses under different atmospheric pressures, and which have already been pointed out by Frankland in his interesting paper on the influence of atmospheric pressure upon some of the phenomena of combustion. The heat furnished by an incandescent or melting platinum-wire is greatly in excess of that required to induce perfect combustion in gun-cotton which is actually in contact with, or in close proximity to, it; and the heat resulting from this combustion, which is contained in the products of the change, will suffice to cause the transformation of the explosion to proceed from particle to particle. But if the pressure of the atmosphere in which the gun-cotton is submitted to the action of heat be reduced, the gases resulting from the combustion of the particles nearest to the source of heat will have a tendency, proportionate to the degree of rarefaction of the air, to pass away into space, and thus to convey away from proximity to the cotton, more or less rapidly and completely, the heat necessary to carry on the combustion established in the first particles. Thus, when the heated wire is enveloped in a considerable body of gun-cotton, the ignition of the entire mass is apparently not instantaneous, if attempted in a highly-rarefied atmosphere, because the products of the combustion first established in the centre of the mass of gun-cotton escape rapidly into space, conveying away from the point of combustion the heat essential for its full maintenance; the gun-cotton therefore undergoes, at first, an imperfect form of combustion, or a kind of metamorphosis different from the normal result of the action of heat upon this material. But the effects of the gradual generation of heated gases from the interior of the mass of cotton are, to impart some of their heat to the material through which they have to escape, as well as gradually to increase the pressure of the atmosphere in the vessel, and thus to diminish the rapidity of their escape; hence, a condition of things is in time arrived at, when the remainder of the gun-cotton undergoes the ordinary metamorphosis, a result which is accelerated by maintaining the original source of heat. If, however, the gun-cotton be employed in a compact form (in the form of twist or thread), and placed only in contact with the source of heat at one point, the heat will be so effectually conveyed away by the escaping gases, that the material will only undergo even what may be termed the secondary combustion or metamorphosis, for a limited period; so that, if a sufficient length of gun-cotton be employed, it will after a short time cease to burn, even imperfectly, because the heat essential for the maintenance of any chemical activity is soon completely abstracted by the escaping gases. These results may obviously be modified in various ways, as shown in the experiments described; thus, by increasing and maintaining the source of heat, independent of the burning cotton, the slow combustion may be maintained through a much greater length of the material until the pressure of the atmosphere is increased, by the products disengaged, to an extent sufficient to admit of a more rapid and perfect metamorphosis being established in the remainder of the material; or the same result may be attained, independently of the continued application of external heat, by employing a thicker mass of cotton, or by using the material in a less compact form. In these cases the maintenance of the chemical change is favoured either by radiation of heat to the cotton, and provision of additional heat, from an external source, to the gases as they escape and expand; or by establishing the change in a greater mass of the material, and thus reducing the rapidity with which the heat will be conveyed away by the escaping gases; or, finally, by allowing the gases, as they escape, to pass to some extent between the fibres of the cotton, and thus favouring the transmission of heat to individual particles of the material.

From other experiments made in a darkened room, it appeared that gun-cotton, when ignited in small quantities in rarefied atmospheres, may exhibit, during its combustion, three distinct luminous phenomena. In the most highly rarefied atmospheres, the only indication of combustion is a beautiful green glow or phosphorescence which surrounds the extremity of the gun-cotton as it is slowly transformed into gases or vapours. When the pressure of the atmosphere is increased to one inch (with the proportion of gun-cotton indicated), a faint yellow flame appears at a short distance from the point of decomposition; and as the pressure is increased, this pale yellow flame increases in size, and eventually appears quite to obliterate the green light. Lastly, when the pressure of the atmosphere, and consequently proportion of the oxygen in the confined space, is considerable, the cotton burns with the ordinary bright yellow flame. There can be no doubt that this final result is due to the almost instantaneous secondary combustion, in the air supplied, of the inflammable gases evolved by the explosion of the gun-cotton. It was thought that the pale yellow flame described might also be due to a combustion (in the air still contained in the vessel) of portions of the gases resulting from the decomposition of the gun-cotton; but a series of experiments, in which nitrogen, instead of air, constituted the rarefied atmosphere, showed that this could not be the case. The results obtained in these experiments corresponded closely to those above described, as far as relates to the production of the green glow and of the pale yellow flame. With rarefied atmospheres of nitrogen, ranging down to one inch of pressure, the green flame was alone obtained, and the pale yellow flame accompanying the green became very marked at a pressure of three inches, as in the experiments with air.

It would seem probable from these results that the mixture of gaseous products obtained by the peculiar change which heat effects in gun-cotton in highly rarefied atmospheres, contains not only combustible bodies, such as carbonic oxide, but also a small proportion of oxidising gas (possibly protoxide of nitrogen, or even oxygen), and that, when the pressure in the atmosphere is sufficiently great, this mixture, which has self-combustible properties, retains sufficient heat as it escapes to burn, more or less completely, according to the degree of rarefaction of the atmosphere.

A series of experiments instituted with gun-cotton in highly rarefied atmospheres of oxygen showed that the additional proportion of this gas thus introduced into the apparatus, beyond that which would have been contained in it with the employment of air of the same rarefaction, affected in a very important manner the behaviour of the explosion under the influence of heat. If eight or ten grains of gun-cotton are placed round the platinum wire, and the pressure of the atmosphere of oxygen in the vessel be reduced to four or three (in inches of mercury), the cotton explodes instantaneously with an intensely bright flash, when the wire is heated. In a series of experiments made under gradually diminished pressures, oxygen being used instead of air, it was found that the gun-cotton exploded instantaneously with a bright flash until the pressure was reduced to 1·2 inch; from this pressure to that of 0·8 inch it still burned with a flash, but not instantaneously; and at pressures below 0·8 inch it no longer burned with a bright flash, but exhibited the comparatively slow combustion, accompanied by the pale yellow flame, which has been spoken of as observed when gun-cotton was ignited in air rarefied to pressures ranging from one inch to twenty-four inches.

The interesting phenomena exhibited by gun-cotton in highly rarefied atmospheres induced the author to make some experiments of a corresponding nature with gunpowder. The same apparatus was used as in the preceding experiments, but a small glass cup was fixed immediately beneath the platinum wire, so that, by bending the latter in the centre, it was made to dip into the cup, and could be covered by grains of gunpowder.

Two grains' weight of small grain gunpowder were heaped over the wire, and the pressure of air in the apparatus was reduced to 0·65 inch. The wire being heated to redness, three or four grains, in immediate proximity to it, fused in a short time and appeared to boil, evolving yellowish vapours, no doubt of sulphur. After the heat had been continued for eight or ten seconds, those particular grains deflagrated, and the remainder of the powder was scattered by the slight explosion, without being ignited. No appreciable depression of the mercurial column occurred during the evolution of the yellowish vapours; the permanent depression, after the deflagration, was only 0·15 inch.

A single piece of gunpowder, weighing fourteen grains, so shaped as to remain in good contact with the wire, was placed over the latter, being supported by the cup. The pressure of air in the apparatus was, as before, equal to 0·65 inch of mercury. There was no perceptible effect for a short time after the wire was first heated to redness; vapours of sulphur were then given off, and slight scintillations were occasionally observed; after a time the wire became deeply buried in the superincumbent mass of gunpowder, which fused and appeared to boil where it was in actual contact with the source of heat. After the lapse of three minutes from the commencement of the experiment, the powder deflagrated. The permanent depression of the mercury column amounted to 1·35 inch.

The experiments were continued with fine-grained gunpowder, and under pressures gradually increased, in successive experiments, from ·07 to 3, in inches of mercury. The same weight of gunpowder (four grains) was used in all the experiments. In those made under a pressure of one inch, the results observed were similar to those obtained in the first experiment. At a pressure of three inches, no grains were ignited singly; the combustion of the powder was effected after an interval of about four seconds, and the greater portion was burned, the combustion becoming more similar to that of gunpowder in open air, but still very slow.

Experiments made with gunpowder in highly rarefied atmospheres of nitrogen furnished results quite similar to those described; nor was any important difference in the character of the phenomena observed when oxygen was substituted for air, except that the scintillations and deflagrations of the powder-grains were in some instances somewhat more brilliant.

The above experiments show that when gunpowder is in contact with an incandescent wire in a highly rarefied atmosphere, the heat is, in the first instance, abstracted to so great an extent by the volatilisation of the sulphur that the particles of powder cannot be raised to the temperature necessary for their ignition until, at any rate, the greater part of that element has been expelled from the mixture, in consequence of which the portions first acted upon by heat will have become less explosive in their character, and require, therefore, a higher temperature for their ignition than in their original condition. The effect of the continued application of heat to the powder thus changed is, to fuse the saltpetre and to establish chemical action between it and the charcoal, which, however, only gradually and occasionally becomes so energetic as to be accompanied by deflagration, because the gas disengaged by the oxidation of the charcoal continues to convey away much of the heat applied, in escaping into the rarefied space. For the same reason, the grains of unaltered powder which are in actual contact with the deflagrating particles are not ignited by the heat resulting from the combustion, but are simply scattered by the rush of escaping gases, at any rate until the pressure in the vessel has been so far increased by their generation as to diminish the rapidity and extent of their expansion at the moment of their escape. The disengagement first of sulphur-vapour and then of gaseous products of chemical change, unattended by phenomena of combustion, when gunpowder is maintained in contact with a red-hot wire in very highly rarefied atmospheres, are results quite in harmony with the observations made by Mitchell, Frankland, and Dufour with regard to the retarding influence of diminished atmospheric pressure upon the combustion of fuses. There is no doubt that the products of decomposition of the gunpowder, obtained under these circumstances, differ greatly from those which result from its exclusion in confined spaces or in the open air under ordinary atmospheric conditions. In all the experiments conducted in the most highly rarefied atmospheres (at pressures of 0·5 to 1·5 in inches of mercury), the contents of the vessel, after the final deflagration of the powder, always possessed a very peculiar odour, similar to that of horse-radish, and due to the production of some sulphur compound. Nitrous acid was also very generally observed among the products.

(To be continued.)

CHEMICAL SOCIETY.

Thursday, April 21, 1864.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

The minutes of the last ordinary meeting were read and confirmed, Mr. Benjamin C. Staples and Mr. Thomas L. G. Bell, having been recently elected, were formally admitted as Fellows of the Society. The members then proceeded to ballot for Mr. James Mactear, Buchanan Street, Glasgow; Mr. George Ward, Leeds; Mr. John Dowling, Dublin, all of whom were duly elected as Fellows; and the foreign members proposed by the council, viz., MM. Dessaignes, Erdmann, and Von Fehling, were likewise unanimously elected.

The President regretted the necessity of having to announce that the sudden illness of Professor J. T. Way would prevent that gentleman addressing the meeting on an agricultural subject of great interest, as he had promised to do; be hoped, however, that Mr. Way's indisposition was not so serious but that he would shortly be able to fulfil his promise. Under these circumstances he would ask Professor Wanklyn to favour the Society with a communication "*On the Hexyl Group.*"

Professor Wanklyn commenced by stating that the results he was about to describe had been worked out conjointly by Dr. Erlenmeyer and himself, and that they were to be taken as a continuation of the researches presented last year to the Society (*vide Jour. Chem. Soc.*, Ser. 2, Vol. I., p. 221). Referring to the advantages of the mode of preparing β iodide of hexyl by the action of hydriodic acid upon mannite, the authors state that they commonly obtain a product equal to 90 per cent. of the theoretical amount. By the action of alcoholic potash on this iodide it was not possible to obtain any appreciable amount of the β hexylic alcohol; the result of this action was hexylene and hydriodic acid, as shown in the following equation:—$C_6H_{13}I = C_6H_{12} + HI$. Small quantities of hexylic alcohol were, indeed, formed, but no practical use could be made of the reaction, since one experiment furnished more than 75 per cent. of the theoretical yield of hexyline, according to the above equation; showing, therefore, but a trifling balance available for the production of the alcohol. The action of sulphide and sulphydrate of potassium upon the iodide did not liberate any hexyline, but formed at once a mercaptan. The author had studied the action of dry hydrochloric acid upon the β hexylic alcohol. The gas was passed into the alcohol to saturation, and the mixture was then heated in sealed tubes to 100° C. Two layers were formed, of which one consisted of aqueous hydrochloric acid. This being removed, the liquid was treated again with dry hydrochloric gas, and again heated under pressure, when the desired combination was completely effected. The product had a boiling point between 120° and 130° C.; and its combustion with chromate of lead afforded numbers which nearly agreed with theory; but there was still a little free alcohol contained in the substance. An attempt to prepare the acetate by digesting the β alcohol with glacial acetic acid was not successful; for after prolonged treatment a trace only of the desired compound was found; but by employing the ready-formed β hexyl-sulphuric acid (described in the former memoir at page 232) the true acetate was easily prepared. One part of hexyl-sulphuric acid digested with eight parts of glacial acetic acid, and subsequently distilled, furnished the pure acetate with liberation of sulphuric acid according to the following equation:—

$$\left.\begin{matrix}C_6H_{13}\\H\end{matrix}\right\}SO_4 + \left.\begin{matrix}C_2H_3O\\H\end{matrix}\right\}O = \left.\begin{matrix}H\\H\end{matrix}\right\}SO_4 + \left.\begin{matrix}C_2H_3O\\C_6H_{13}\end{matrix}\right\}O.$$

The acetate boils at 155°—157° C., and is so stable that an exposure for twelve hours to the temperature of 200° C. did not alter the character of the substance in the slightest degree. Alcohol potash decomposes it in a perfectly different manner to that described in the case of the β iodide of hexyl; for not a trace of hexylene was formed. The β alcohol, when acted upon by sodium, furnished a double compound, which has yet to be fully examined. The preparation of β hexyl-mercaptan, already alluded to, was in the next place more minutely described. It appears to be the sole product of the action of sulph-hydrate of potassium upon the β alcohol. This body combines readily both with the red oxide and the perchloride of mercury. The boiling point was observed to be 142° C. under a pressure of 760 mm. Its odour was similar to the other mercaptans, but not persistent. It combines both with solid and aqueous potash; but on gently heating the solution an oily layer separates out which remains to be further examined. The author showed an experiment which demonstrated the facility with which the potash solution of β hexyl-mercaptan underwent a change by the application of a moderate heat. The sealed tube, at first perfectly transparent, soon became turbid, and allowed an oil to separate. Sodium evolves hydrogen from the mercaptan, and forms a white solid body.

The President, in moving a vote of thanks to Professor Wanklyn, pointedly referred to the interesting and important difference noticed by the author in the reactions of potash upon the acetate and the iodide of hexyl.

In reply to Dr. Odling, the Author explained that the product of the decomposition of the acetate had all the properties of the β alcohol; and in answer to Dr. Hofmann, stated that he had not yet fully examined the action of ammonia on the β iodide of hexyl, but, so far as he could affirm at present, there appeared to be much hexylene liberated and but a trace of alkali formed.

Dr. Hofmann stated that Professor Wurtz, in operating upon the β iodide of amyl, found that digestion with ammonia disengaged much amylene, and gave rise to the production of a basic body, which was not, however, the ordinary amylamine.

Dr. Frankland having inquired about the optical properties of the α and β hexylic alcohol,

Professor Wanklyn said he had not yet found an opportunity of examining their action upon light.

After a few remarks having reference to the theoretical constitution of bodies in this class and other series closely related.

The President requested Dr. Redwood to read a communication from Professor R. V. Tuson, descriptive of the alkaloids he had discovered in castor and croton seeds.

The author commenced by referring to the importance to be attached to the study of plants of the genera *Euphorbiaceæ*, which had furnished many valuable medicinal remedies. Although the oils expressed from castor and croton seeds had been so long employed in medicine, the isolation of their active principles had not yet been accomplished. The experiments about to be detailed had resulted in the identification of a new organic alkaloid, to which the author applied the name *Ricinine*. For the preparation of this substance the following method was adopted:—The crushed castor seeds were exhausted with water, the aqueous solution being filtered and evaporated over a water bath. The residue was then treated with boiling alcohol and allowed to cool, in order that certain resinous impurities might separate, then filtered, the solution partially evaporated and allowed to stand at rest for some time, when the impure ricinine crystallised out. The crude product was then purified by solution in alcohol and digesting with animal charcoal. The substance then took the form of rectangular prisms and plates, colourless, and having a feebly bitter taste, somewhat like that of the oil of bitter almonds. It may be sublimed with trifling loss. Heated on platinum foil, it melts and burns with a fuligenous flame. Water and alcohol dissolve ricinine, but it is insoluble in ether and benzol. Nitrogen is an elementary component, since the pure substance gives off ammonia on heating with caustic potash. It dissolves apparently without alteration in concentrated sulphuric acid. Hot and cold nitric acid likewise dissolve it without production of red vapours, and on evaporation furnish (a nitro-compound ?) in colourless, acicular crystals. Hydrochloric acid forms with it a salt which is prone to decomposition during evaporation. When to the aqueous solution of this hydrochlorate is added bichloride of platinum no precipitate is formed, but upon slowly evaporating the mixture very definite orange octohedra crystallise out. The cold saturated solution becomes quite solid on mixing with perchloride of mercury from the formation of beautiful silky crystals of the double salt, which were exhibited. By the action of water on castor oil itself, the author had extracted ricinine perfectly similar to that obtained from the crushed seeds. The administration of two grains of the new alkaloid to a rabbit was not followed by any distressing symptoms; it was neither poisonous nor aperient. By a similar process the author extracted from croton seeds a crystalline organic principle very like cascarilline, but there were differences observed in their comportment with sulphuric and hydrochloric acids.

The PRESIDENT moved a vote of thanks to Professor Tuson for his interesting communication. If he had rightly understood the author's statement, it appeared that the basic substance which he had succeeded in separating from castor and croton seeds was not the purgative principle, but a less active ingredient, which, however, deserved fuller investigation.

Dr. ODLING then read a paper, by Professor A. KEKULÉ, entitled "*On the Action of Hydrobromic Acid and of Hydriodic Acid upon Polyatomic Acids, and on the Behaviour of the Iodo-substitution Compounds towards Hydriodic Acid.*" The author believed that the atomicity of the organic acids was a more important consideration than their basicity, and that in reviewing their theoretical constitution it was possible to conceive hydrogen as existing in three distinct forms of combination; thus, the hydrogen may belong to the radical according to the requirement of the theory of types; or, secondly, the hydrogen may be substituted by metals (hydrogen of acids); or, thirdly, it cannot be replaced in this manner (hydrogen of alcohols). Those polyatomic acids whose basicity is less than their atomicity are to be ranked, with respect to the nature of the typical atoms of hydrogen, between the alcohols and those organic acids whose basicity is equal to their atomicity. The primary cause of these differences must be looked for in the nature of those atoms which surround, or are associated with, the respective hydrogen atoms; thus it would appear that the chemical nature of the space ordinarily occupied by the hydrogen atoms must be the resultant of all the forces of attraction which the various atoms surrounding this space can exercise. With respect to the constitution of glycolic acid and some other polybasic acids, whose basicity is less than their atomicity, and in which the typical atoms of hydrogen are not precisely of the same value, the author considered that they behave as though one side of the molecule were composed of an alcohol, and the other of an acid. In proceeding to support these theoretical views by facts, the author mentioned the circumstance that the alcohols give rise to the production of chlorides and bromides when acted upon by hydrochloric or hydrobromic acid, thus,—

$$C_2H_6O + HBr = H_2O + C_2H_5Br;$$

whereas with acids the reaction is inverted, *i.e.*, the chloride or bromide undergoes decomposition by water; for example:—

$$C_2H_3OBr + H_2O = HBr + C_2H_4O_2.$$

If, now, in glycolic acid and lactic acid one side of the molecule behaves like an alcohol, these acids ought to undergo the same transformation as the alcohols by the action of hydrobromic acid, forming bromides with elimination of water. These bromides are known to be identical with the bromine substitution products of acetic acid and propionic acid; the same bodies ought, therefore, to be produced as kinds of ethers from glycolic acid and lactic acid.

1. $C_2H_4O_3 + HBr = H_2O + C_2H_3BrO_2.$
2. $C_3H_6O_3 + HBr = H_2O + C_3H_5BrO_2.$

In a similar manner the bibasic, triatomic, malic acid should furnish bromo-succinic acid, thus—

$$C_4H_6O_5 + HBr = H_2O + C_4H_5BrO_4.$$

and the bibasic, quadratomic tartaric acid (containing two alcoholic hydrogen atoms), in like manner the bibromo-succinic acid—

$$C_4H_6O_6 + 2HBr = 2H_2O + C_4H_4Br_2O_4.$$

The author, in the next place, described the results of several experiments upon glycolic, lactic, and malic acids which generally supported these views. In proceeding to discuss the nature of the action of iodine upon iodo-substitution compounds, the author pointed out certain differences in the behaviour of chlorine and bromine on the one hand, and of iodine, which are easily accounted for by the varying degrees of affinity which these elements possess for hydrogen. Referring, then, to the iodo-substitutes, he found that iodo-acetic acid (prepared according to the process of Perkin and Duppa), was easily decomposed by fuming hydriodic acid with liberation of iodine; likewise the iodo-propionic acid of Beilstein was similarly affected at a higher temperature, with regeneration of the acids—

1. $C_2H_3IO_2 + HI = C_2H_4O_2 + I_2.$
2. $C_3H_5IO_2 + HI = C_3H_6O_2 + I_2.$

In the event of this action of hydriodic acid upon the iodo-substitution compounds of organic acids being proved to be a general reaction, it is evident that such substitution compounds can never be formed directly by the action of iodine upon organic acids. When iodo-salicylic acid was heated with hydriodic acid it was found that much free iodine was liberated, and that salicylic acid was regenerated according to the equation—

$$C_7H_5IO_3 + HI = C_7H_6O_3 + I_2.$$

This observation tended to cast doubt upon the assertions of Kolbe and Lautemann, whose experience was stated to be directly contrary. It was possible, however, to induce the formation of iodo-salicylic acid by the intervention of an alkali, and the following equation was true—

$$C_7H_6O_3 + I_2 + KHO = C_7H_5IO_3 + H_2O + KI.$$

Under these circumstances, a red body of the formula—

$$C_6H_2I_2O$$

was always formed, as had been previously noticed by Lautemann. The presence of iodic acid was found to assist the action of iodine upon these organic acids. When applying the hydriodic acid to the reduction of the polyatomic acids, the author found no difficulty in converting glycolic acid into acetic acid. There were probably two stages in the reaction, the second of which was a kind of retrograde substitution. The conversion of glycolic into acetic acid might be shown by the following equations—

$$C_2H_4O_3 + HI = H_2O + C_2H_3IO_2.$$
$$C_2H_3IO_2 + HI = I_2 + C_2H_4O_2.$$

The author considered these reactions might be applicable in a great number of similar instances, several of which were indicated in tho concluding paragraph of his communication, and to the elucidation of some of these points his experiments were now being directed. Ho conceived the following reactions to be possible—

$$1.\ CHI_3 + HI = I_2 + CH_2I_2.$$

Iodoform. Iodide of Methylene.

$$2.\ C_2H_4I_2 + HI = I_2 + C_2H_5I.$$

Iodide of ethylene. Iodide of ethyl.

$$3.\ C_2H_4I_2 + CH_3I = I_2 + C_2H_4\,(CH_3)\,I = C_3H_7I.$$

Iodide of ethylene. Iodide of methyl. Iodide of propyl.

$$4.\ C_2H_3IO_2 + CH_3I = I_2 + C_2H_3\,(CH_3)O_2 = C_3H_6O_2.$$

Iod acetic acid. Iodide of methyl. Propionic acid.

The **President** could not give his assent to all the propositions stated in the interesting communication of Professor Kekulé. The distinction between alcohol-hydrogen and basic hydrogen was, he considered, unnecessary, and not supported by fact; aud the speculations regarding the existeoce of spaces around the atoms of hydrogen were not good in theory.

Mr. **Perkin** stated that ho had already published in the Chemical News* some three or four years ago an account of the conversion of brom-acetic acid into lactic ether, and several particulars relating to glycolic and lactic acids, which were now brought forward as newly-ascertained facts.

Professor **Wanklyn** hod made experiments on the action of hydriodic acid upon the bromide and iodide of ethylene, and found that iodine was liberated, and, in fact, that the reaction which Professor Kekulé uow speculated upon was already ascertained to be truo.

Dr. **Hofmann** stated that ho had listened with great interest to the important developments in Professor Kekulé's paper, more especially to tbose which had reference to the action of hydriodic acid upon iodo-substitutes. The action of hydriodio acid upon iod-acetic and iodo-propionic acids was perfectly analogous to that of hydriodic acid upon iod-aniline, a detailed account of which he had laid before the Society at one of their meetings in tho last month.†

$$C_6H_6IN + HI = C_6H_7N + II.$$

Iod-aniline. Aniline.

$$C_2H_3IO_2 + HI = C_2H_4O_2 + II.$$

Iod-acetic acid. Acetic acid.

But he had gone oven further, and shown that by employing, instead of hydriodic acid, hydriodic ether (iodide of ethyl) the radical ethyl might be substituted for the lodine contained in lod-aniline, which was thus easily converted into ethylaniline.

$$C_6H_6IN + C_2H_5I = C_6H_6\,(C_2H_5)\,N + II.$$

Iod-aniline. Ethylaniline.

If he took this opportunity of reminding the Society of these experiments, he was far from wishing to diminish the value or the originality of Professor Kekulé's observations, who had obviously been led to similar results quite independently, and unacquainted with the experiments just quoted. But Professor Kekulé having at the conclusion of his paper expressed his intention to pursue this inquiry, and to examine the action of lodide of ethyl upon iodo-substitutes, be (Dr. Hofmann) considered it desirable, by reminding the Society of the results he had laid before them, to reserve for himself the right of further elaborating a reaction which he had been tho first to point out. The speaker then mentioned that the effect of bydriodic acid upon iodo-substitutes was readily traceable in the preparation of iod-aniline and similar substances. The best result was always obtained by employing a quantity of iodine sufficient only to iodinate half the amount of base, so as to eliminate the hydriodic acid generoted in the form of hydriodate of aniline.

$$C_6H_7N + 2I = C_6H_6IN + C_6H_7N,HI$$

Aniline. Iodaniline. Hydriodate of aniline.

The same observation applied to the preparation of iodotoluidine, C_7H_8IN, a base of remarkable beauty, which he had obtained during the last few days. In conclusion, Dr. Hofmann remarked that the formation of diniodide of methylene from iodoform by simple exposure to heat, which he had pointed out some years ago to the Society,‡ was no doubt a secondary product of the action of hydriodic acid, separated during the destruction of one portion upon another portion of the iodoform not yet decomposed. Large quantities of iodine were separated in this reaction. The results thus obtained might be considered as an experimental anticipation of the suggestion thrown out by Professor Kekulé, that the action of hydriodic acid upon iodoform would probably give rise to the formation of diniodide of methylene.

The **President** was happy in being oble to announco to the meeting the pleasing intelligence that Sir Benjamin Brodie had so far recovered from tbe effects of his recent accident that he would be prepared to address the Society at its next meeting on May 5, when he would deliver his promised lecture "*On the Organic Peroxides Theoretically Considered.*" The meeting was then adjourned until that date.

PHARMACEUTICAL SOCIETY.

April 20.

Dr. Attfield continued his criticism of the Pharmacopœia, with the view of showing how far the authors had succeeded in representing the advancement which has been made iu pharmaceutical science since the publication of the last Pharmacopœias. Resuming tho consideration of the Liquors, the lecturer remarked that since the object of publishing a pharmacopœia is the instruction of the apothecary and pbarmacentist rather than the manufacturer, it was to be regretted that the simple process suggested by Professor Redwood for the preparation of liquor potassæ had not been introduced. This process consists in simply shaking together in water carbonate of potash and an excess of slaked lime. Iu this way a purer solution is obtained than by the Pharmacopœia process. Noticing the Misturæ, Dr. Attfield observed that the addition of glacial acetio acid to dissolve the creosote in misturæ creosoti seemed unnecessary, since Pereira asserted that one part of creosote will dissolve in eighty parts of water, and in the mixture one part of creosote is ordered with 440 of water. Speaking of misturæ ferri, he regretted that bruised myrrh was uot ordered in place of the powder, inasmuch as it bas beeu shown that a much more elegant mixture is made when the myrrh is carefully rubbed down. Passing to the Pilulæ, Dr. Attfield referred to the experiments of Mr. Tyson, an excellent pharmaceutist, as well as medical practitioner, who long ago pointed out that a much more efficacioos pilula hydrargyri is made by employing the protoxide instead of metallie mercury. Mr. Tyson's formula was as follows :—

Hydrargyri protoxidi, ʒj. ;
Conf. rosæ gall, ʒiij. ;
Pulv. flor. onthem, ʒss. M.

This pill, containing only balf the quantity of mercury, Mr. Tysou said was the samo colour as blue pill, far superior to it, always certain, and made in a few minutes. The difficulty was in getting a slate-coloured protoxide, but the author showed that this could always be obtained by treating calomel with liquor potassæ and a little ammonia.

Many have asked the use of hydrochloric acid iu the precipitation of podophyllum resin. Dr. Attfield explained that the object was the precipitation of hydrochlorate of *berberine* (not beberine), which is present in podophyllum, and is supposed to contribute to the action of the drug. Referring to potassæ permanganas, the lecturer observed that the process of Böttger, already given in the Chemical News, is preferable to that of the Pharmacopœia, since it excludes the possibility of having the permanganate contaminated by the presence of sulphate of potash. The roundabout process for preparing neutral sulphate of potash from the bisulphate was next noticed, and Dr. Attfield pointed out that it is quite sufficient to add carbonate of potash until effervescence ceased, and then evaporate and crystallise. The form for antimonial powder the lecturer regarded as a feature in the Pharmacopœia. It is identical with that recommended as early as 1842 by the Mr. Tyson already referred to. He made many analyses and many physiological experiments, and came to the conclusion that there were only two antimonial preparations worthy of notice—the tartrate and the oxide. At length he devised the mixture of oxide and phosphate of lime, such as we have in the British Pharmacopœia, which, writing in 1842, he expressed a great wish to see introduced into the London Pharmacopœia. We pass by the lecturer's notice of the powders. Coming to quinæ sulphas, he remarked that, in testing the purity of this salt by the directions given, "pure" ether cannot be employed, since the amount stated is not sufficient to take up all the quina. The officinal ether will answer, and the word "pure" should have been omitted. Referring to santonin, Dr. Attfield pointed out that no test for the presence of strychnia is given in the Pharmacopœia. A case is recorded in which a fatal result followed the administration of santonin, which was afterwards found to contain strychnia. Speaking of sodæ arsenias, the lecturer observed that if this salt is prescribed in pills, the substance which ought to be dispensed is the salt with 14 atoms of water, and not the anhydrous salt which is used for the preparation of the liquor; and, therefore, prescribers must remember that the former contains only 37 per cent. of arsenic acid, while the latter contains nearly 62. Sodæ carbonas exsicatta, Dr. Attfield thinks, should have been ordered to be prepared from the bicarbonate in accordance with the recommendation of several pharmaceutists. This yields a white, pulverulent, easily-soluble monocarbonate, superior in every respect to the hard cake formerly obtained by heating the carbonate to redness. In speaking of the new formula for spiritus ammoniæ aromaticus, the lecturer mentioned that the recommendations of some pharmaceutists have been carried out in the Pharmacopœia. The form for syrupus ferri phosphatis is nearly identical with that given by Mr. Gale. (See vol. i., p. 270, Chemical News.) The use of granulated sulphate of iron Dr. Attfield regards as an unnecessary refinement. Each drachm of the syrup contains one grain of phosphate of iron ($3FeOPO_5$) and twenty-five minims of diluted phosphoric acid. The lecturer next referred at some length to the tinctures, and quoted the experiments of Burton, who determined how long it took to exhaust the materials of many tinctures when they were suspended in a bag at the upper part of the menstruum. The results showed that forty-eight hours sufficed for most tinctures, the exceptions being those which the British Pharmacopœia orders to be macerated for a longer period, *e.g.*, tinct. opii. and assafœtidæ, and some others. Dr. Attfield, however, suggested that the subject still required further investigation, which would probably result in the discovery of improved processes for each tincture. In making tinct. quinæ, it was pointed out that the whole of the quinine may be dissolved by digesting for a time at 90° to 100°. The deposit which sometimes forms, Mr. Henningway states, is caused by the orange peel, which is found to vary in nature.

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* *Vide* Chemical News, vol. iii., p. 81.

† *Vide* Chemical News, p. 163 of present volume.

‡ *Journal of the Chemical Society*, XIII., 65.

Unguentum hydrarygri, Dr. Attfield stated, should be prepared at once from the black oxide, according to the recommendation of Mr. Tyson, since it has been shown that metallic mercury is incapable of permeating living tissue, and, therefore, the efficacy of the ointment must be entirely owing to the black oxide it contains. The process for ung. hydrarg. nitratis he commended. The form for vinum ferri is of doubtful value, since a deposit soon occurs, and the strength of the new wine is as uncertain as that of the old. An iron wine of constant strength and appearance is still needed.

In conclusion, Dr. Attfield remarked that although the fusion of the three Pharmacopœias into one must be considered to have been accomplished in a most satisfactory manner, and be a source of congratulation to all, yet it is open to serious question whether the compilers of the work have accurately represented the advancement made in pharmacy during the past thirteen years. The comments made and published show that while the materia medica part of the book may be regarded as a success, the preparations and compounds are, to a great extent, a failure. Such a result may be fairly ascribed to want of pharmaceutical co-operation in the work of compilation. Had the book been thrown open to comment before publication instead of after, or the opinions of pharmaceutists elicited in some other way, a Pharmacopœia might have been produced which would have commanded the confidence of all interested in its pages.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, March 4, 1864.

Sir Henry Holland, *Bart., M.D., D.C.L., F.R.S., Vice-President, in the Chair.*

Professor G. G. Stokes, M.A., D.C.L., Sec. R.S., read a paper "*On the Discrimination of Organic Bodies by their Optical Properties.*"

The chemist who deals with the chemistry of inorganic substances has ordinarily under his hands bodies endowed with very definite reactions, and possessing great stability, so as to permit of the employment of energetic reagents. Accordingly he may afford to dispense with the aids supplied by the optical properties of bodies, though even to him they might be of material assistance. The properties alluded to are such as can be applied to the scrutiny of organic substances; and therefore the examination of the bright lines in flames and incandescent vapours is not considered. This application of optical observation, though not new in principle (for it was clearly enunciated by Mr. Fox Talbot more than thirty years ago), was hardly followed out in relation to chemistry, and remained almost unknown to chemists until the publication of the researches of Professors Bunsen and Kirchhoff, in consequence of which it has now become universal.

But while the chemist who attends to inorganic compounds may confine himself without much loss to the generally-recognised modes of research, it is to his cost that the organic chemist, especially one who occupies himself with proximate analysis, neglects the immense assistance which in many cases would be afforded him by optical examination of the substances under his hands. It is true that the method is of limited application, for a great number of substances possess no marked optical characters; but when such substances do present themselves, their optical characters afford facilities for their chemical study of which chemists generally have at present little conception.

Two distinct objects may be had in view in seeking for such information as optics can supply relative to the characters of a chemical substance. Among the vast number of substances which chemists have now succeeded in isolating or preparing, and which, in many cases, have been but little studied, it often becomes a question whether two substances, obtained in different ways, are or are not identical. In such cases an optical comparison of the bodies will either add to the evidence of their identity, the force of the additional evidence being greater or less according as their optical characters are more or less marked, or will establish a difference between substances which might otherwise erroneously have been supposed to be identical.

The second object is that of enabling us to follow a particular substance through mixtures containing it, and thereby to determine its principal reactions before it has been isolated, or even when there is small hope of being able to isolate it; and to demonstrate the existence of a common proximate element in mixtures obtained from two different sources. Under this head should be classed the detection of mixtures in what were supposed to be solutions of single substances.*

Setting aside the labour of quantitative determinations carried out by well-recognised methods, the second object is that the attainment of which is by far the more difficult. It involves the methods of examination required for the first object, and more besides; and it is that which is chiefly kept in view in the present discourse.

The optical properties of bodies, properly speaking, include every relation of the bodies to light; but it is by no means every such relation that is available for the object in view. Refractive power, for instance, though constituting, like specific gravity, &c., one of the characters of any particular pure substance, is useless for the purpose of following a substance in a mixture containing it. The same may be said of dispersive power. The properties which are of most use for our object are—first, absorption; and, secondly, fluorescence.

Colour has long been employed as a distinctive character of bodies; as, for example, we say that the salts of oxide of copper are mostly blue. The colour, however, of a body gives but very imperfect information respecting that property on which the colour depends; for the same tint may be made up in an infinite number of ways from the constituents of white light. In order to observe what it is that the body does to each constituent, we must examine it in a pure spectrum. [The formation of a pure spectrum was then explained, and such a spectrum was formed on a screen by the aid of the electric light. On holding a cell containing a salt of copper in front of the screen, and moving it from the red to the violet, it was shown to cast a shadow in the red as if the fluid had been ink, while in the blue rays it might have been supposed to have been water. Chromate of potash similarly treated gave the reverse effect, being transparent in the red and opaque in the blue. Of course, the transition from transparency to opacity was not abrupt; and for intermediate colours the fluids caused a partial darkening. Indeed, to speak with mathematical rigour, the darkening is not absolute even when it appears the greatest; but the light let through is so feeble that it eludes our senses. In this way the behaviour of the substance may be examined with reference to the various kinds of light one after another; but in order to see at one glance its behaviour with respect to all kinds, it is merely requisite to hold the body so as to intercept the whole beam which forms the spectrum, to place it, for instance, immediately in front of the slit.]

To judge from the two examples just given, it might be supposed that the observation of the colour would give almost as much information as analysis by the prism. To show how far this is from being the case, two fluids very similar in colour, port wine and a solution of blood, were next examined. The former merely caused a general absorption of the more refrangible rays; the latter exhibited two well-marked dark bands in the yellow and green. These bands, first noticed by Hoppe, are eminently characteristic of blood, and afford a good example of the facilities which optical examination affords for following a substance which possesses distinctive characters of this nature. On adding to a solution of blood a particular salt of copper (any ordinary copper salt, with the addition of a tartrate to prevent precipitation, and then carbonate of soda), a fluid was obtained utterly unlike blood in colour, but showing the characteristic bands of blood, while at the same time a good deal of the red was absorbed, as it would have been by the copper salt alone. On adding, on the other hand, acetic acid to a solution of blood, the colour was merely changed to a browner red, without any precipitate being produced. Nevertheless, in the spectrum of this fluid the bands of blood had wholly vanished, while another set of bands less intense, but still very characteristic, made their appearance. This alone, however, does not decide whether the colouring matter is decomposed or not by the acid; for as blood is an alkaline fluid, the change might be supposed to be merely analogous to the reddening of litmus. To decide the question we must examine the spectrum when the fluid is again rendered alkaline, suppose by ammonia, which does not affect the absorption bands of blood. The direct addition of ammonia to the acid mixture causes a dense precipitate, which contains the colouring matter, which may, however, be separated by the use merely of acetic acid and ether, of which the former was already used, and the latter does not affect the colouring matter of blood. This solution gives the same characteristic spectrum as blood to which acetic acid has been added; but now there is no difficulty in obtaining the colouring matter in an ammoniacal solution. In the spectrum of this solution, the sharp absorption bands of blood do not appear, but instead thereof there is a single band a little nearer to the red, and comparatively vague [this was shown on a screen]. This difference of spectra decides the question, and proves that hæmatin (the colouring matter prepared by acid, &c.) is, as Hoppe stated, a product of decomposition.

The spectrum of blood may be turned to account still further in relation to the chemical nature of that substance. The colouring matter contains, as is well known, a large quantity of iron; and it might be supposed that the colour was due to some salt of iron, more especially as some salts of peroxide of iron, sulphocyanide for instance, have a blood-red colour. But there is found a strong general resemblance between salts of the same metallic oxide as regards the character of their absorption. Thus the salts of sesquioxide of uranium show a remarkable system of bands of absorption in the more refrangible part of the spectrum. The number and position of the bands differ a little from one salt to another; but there is the strongest family likeness between the different salts. Salts of sesquioxide of iron in a similar manner have a family likeness in the vagueness of the absorption, which creeps on from one part of the spectrum to another without presenting any rapid transitions from comparative transparency to opacity and the converse. [The spectrum of sulphocyanide of peroxide of iron was shown for the sake of contrasting with blood.] Hence the appearance of such a peculiar system of bands of absorption in blood would negative the supposition that its colour is due to a salt of iron as such, even had we no other means of deciding. The assemblage of the facts with which we are acquainted seems to show that the colouring matter is some complex compound of the five elements, oxygen, hydrogen, carbon, nitrogen, and iron, which under the action of acids and otherwise, splits into hæmatin and globulin.

This example was dwelt on, not for its own sake, but because general methods are most readily apprehended in their application to particular examples. To show one example of the discrimination which may be effected by the prism, the spectra were exhibited of the two kinds of red glass which (not to mention certain inferior kinds) are in common use, and which are coloured, one by gold, and the other by suboxide of copper. Both kinds exhibit a single band of absorption near the yellow or green; but the band of the gold glass is situated very sensibly nearer to the blue end of the spectrum than that of the copper glass.

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* The detection of mixtures by the microscopic examination of intermingled crystals properly belongs to the first head, the question which the observer proposes to himself being, in fact, whether the pure substances forming the individual crystals are or are not identical.

In the experiments actually shown, a battery of fifty cells and complex apparatus were employed, involving much trouble and expense. But this was only required for projecting the spectra on a screen, so as to be visible to a whole audience. To see them, nothing more is required than to place the fluid to be examined (contained, suppose) in a test tube, behind a slit, and to view it through a small prism applied to the naked eye, different strengths of solution being tried in succession. In this way the bands may be seen by any one in far greater perfection than when, for the purpose of a lecture, they are thrown on a screen.

(To be continued.)

ACADEMY OF SCIENCES.

April 18.

A note entitled "*Theoretical Researches on the Formation of Positive Photographic Prints*," by MM. Davanne and Girard, was presented. The authors do not seem to have discovered anything new in the course of their researches, unless the following method of restoring faded prints be considered a novelty :—" If, in consequence of defective preparations, a print fades (yellow), the change may be arrested, and a part of its primitive brilliancy restored by toning it afresh in *a concentrated solution of neutral chloride of gold*. A note "*On the Action of Chlorine on Methyl*," by Mr. Schorlemmer, was read. The author exposed to diffused light bottles full of a mixture of equal volumes of chlorine and methyl, and so obtained chlorhydric ether of vioic alcohol and a monochlorinated compound of the same ether. M. F. Pisani presented *An Analysis and Chemical Study of the Mineral Pollux* found in the island of Elba. This rare mineral had only been analysed by Plattner, who found it to be principally composed of silica, alumina, potash, and soda, but could only make the percentage sum of the constituents 92·75. M. Pisani has recently analysed a specimen of pollux, and found it to contain 34 *per cent. of cæsium*. The author points out that Plattner took the precipitated chloro-platinate as a potassium compound, and calculated accordingly; but if the chloroplatinate be calculated for cæsium, the numbers are found to closely agree with those obtained by M. Pisani himself. This shows the importance of setting down the results of analyses conscientiously without making up the "loss."

M. Remalé communicated a note "*On the Sulphur Compounds of Uranium*." The author poured an excess of sulphide of ammonium into a solution of nitrate of uranium in alcohol, and obtained a brown precipitate which he believes to be a *sulphide of uranyle* $(Ur_2O_2)S$. M. Peligot supposes the existence of the radical uranyle to account for the circumstance that sesquioxide of uranium forms neutral salts with one equivalent of acid. Thus, the sesquioxide is the oxide of uranyle $(Ur_2O_2)O$.

MM. Berthelot and Fleurica contributed a note "*On the Proportion of Tartaric Acid in Grape Juice and Wine*." The researches of the authors show that the vinous fermentation is a very complicated process—much more complicated than the alcoholic fermentation properly so-called. It seems that in the course of fermentation much of the acidity of the grape juice disappears beyond that which can be accounted for by the precipitation of cream of tartar—" a circumstance the more unexpected," say the authors, " since the fermentation itself produces acids."

Chemical Society. — The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following paper will be read :—" On the Organic Peroxides Theoretically Considered," by Sir B. C. Brodie.

NOTICES OF BOOKS.

International Exhibition : Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(EIGHTEENTH NOTICE.)

(Continued from page 154.)

We come now to the section of Report devoted to the industry of distilled hydrocarbons. The reporter here gracefully acknowledges the assistance of Dr. Frankland, who seems to have furnished a chronological sketch of the industry, interwoven with descriptions of products and processes.

It was just before the Exhibition of 1851 that Mr. Young began to distil boghead coal at a low red heat, and so commenced in this country the manufacture which has received such an extraordinary development. In 1857 Mr. De La Rue took out a patent for distilling Rangoon tar, first with a current of steam to remove the lighter oils, and then with superheated steam to obtain paraffin. At the date of the French Exhibition (in 1855) the condition of the industry is thus summed up :—1. Boghead coal was being largely distilled for the liquid and solid products, used, for the most part, as lubricating, but also to some extent as illuminating agents. 2. The same products were also obtained from gas tar. 3. Bituminous schist, resin, and peat were being largely worked for similar purposes, chiefly for illuminating agents. 4. Lastly, Mr. De La Rue had called attention to the value of native tar as a source of similar products.

This, it must be confessed, is but a very meagre sketch of the early (some will say late) history of the industry of distilled hydrocarbons; but it is all this report affords us, and we pass on to the processes of distillation and purification now in use. Mr. Young, as everybody now knows, distils boghead coal at a low red heat; the crude oil so obtained is treated with a current of steam to remove the naptha; the residue is then treated with strong sulphuric acid, whereby naphthaline and a number of products of a similar composition to olefiant gas are decomposed. Agitation with a strong solution of caustic soda now causes the separation of tarry matter, which takes its place between the soda lye and the purified oil, when the mixture is left at rest. The oil is now run off, and rectified by distillation; the more volatile part is sold as an illuminating, and the less volatile as a lubricating agent.

Gas-tar is treated differently. It is first rectified, and the distillate is then mixed with a solution of chloride of lime. The mixture is then briskly agitated, and diluted hydrochloric acid is added until all the chlorine is expelled from the chloride. The more alterable portion of the oil is thus oxidised, and subsequent treatment with soda lye, as in the former instance, separates the tar, and leaves the supernatant oil free for rectification. The richer tar from Scotch cannels it seems can be profitably treated in this way.

Petroleum or rock oil, from the United States and Canada, are, however, at present formidable competitors with the distilled oils; but how little the manufacture of the oils has been affected may be judged from the statement made in this report, that the production of paraffin oil in the United Kingdom "during the last year [1862, we presume] reached the enormous amount of 2,300,000 gallons."

The manufacture of paraffin and the accessory products from a light coloured lignite, is carried on to a considerable extent in Prussia, and a very good description of the processes employed is given in the Report. The lignite appears to be first distilled for tar, which is first freed from water, and then rectified: the distillate now obtained is treated with caustic soda to remove carbolic acid. After the separation of the carbolate of soda solution, the oils are treated with sulphuric acid, and the purification carried on in the ordinary way. The acid solution separated in this latter part of the process is mixed with the alkaline carbolate and the crude carbolic acid obtained is used to impregnate railway sleepers, while the sulphate of soda is sold to alkali makers. The method used for purifying the paraffin we need not notice. One ton of this light coloured lignite it seems will yield 31·5 lbs. of hard paraffin, 31·5 lbs. of soft paraffin, 70 lbs. of photogen (lighter oil) and 80 lbs. of solar (heavier) oil. The softer paraffin is mixed with stearine and made into candles.

We may quote here the results obtained by Wagenmann, who made numerous determinations of the amounts of products obtainable by the distillation of peat, lignite, and bituminous shale.

	Photogen, sp. gr. 0·815-0·835	Solar Oil, sp. gr 0·870-0·890	Crude Solid Paraffin.
Hard, dark brown peat, containing 33·58 per cent. of water, and 6·76 per cent. of ash	0·435	1·10	1·943
Brown fibrous peat, containing 36·23 per cent. of water, and 5·49 per cent. of ash	0·380	1·124	2·189
Hard, dark-brown lignite, occurring in small fragments, and containing 45·26 per cent. of water, and 9·83 per cent. of ash	0·810	3·940	3·910
Bituminous shale, containing 19·9 per cent. of water, and 23·52 per cent. of ash	8·160	1·590	12·870

The results seem to show that the extraction of these illuminating and lubricating agents from peat is not likely to be profitable as long as they have to compete with the products from coal and lignite.

Photogen, according to Herr Wagenmann, "should be very mobile, as it has frequently to ascend a wick to the height of six inches. The best has the sp. gr. 0·815 to 9·835. Those which have the sp. gr. of only 0·78 are dangerous, as they contain oils which boil at 60° C., and readily forming explosive mixtures in the air-spaces of the lamps in which they are consumed. On the other hand, photogen sp. gr. 0·840 and upwards is nearly useless, as it cannot ascend a wick with sufficient facility.

"Solar oil should not contain any oils of less sp. gr. than 0·870, nor more than 0·920. Its sp. gr. generally ranges between 0·885 and 0·895. Cooled to 10° C., it ought not to deposit paraffin; and when agitated the bubbles of air ought not to rise to the surface more rapidly than in colza oil.

"Lubricating oil ought to have a sp. gr. varying from 0·920 to 0·950, and to possess but a very slight odour. It is frequently mixed with Gallipoli oil. Although it contains paraffin, it ought not to deposit any when cooled to 2° C."

The report gives no account of the practical mode and the results of coal distillation in this country, which it is remarked "is a source of considerable disappointment."

We can notice but briefly the Russian works, near Bakou, on the Caspian. Here the inflammable gas which issues from the earth is collected in gasholders, and used as a source of heat for the distillation of the petroleum, and also a bitumen, called *naphthagil*. There is another factory on the island Svatoi, on the Caspian, where a substance resembling dark coloured wax and named *naphthadehyl* is distilled. The substance is found in large quantities on the island, and also on the eastern shores of the Caspian. The successful working of these deposits suggests the possibility of the similar utilisation of the analogous deposit found in Derbyshire. In the hope of this, it seems that this substance, locally known as "Devil's dung," is being stored in caves on the High Peak.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

3307. John Dale and Heinrich Caro, Manchester, "Improvements in obtaining colouring matters for dyeing and printing."—Petition recorded December 31, 1863.

543. Alfred Ford, Trafalgar Works, Peckham, Surrey, "An improved method of manufacturing floor cloth."—Petition recorded March 4, 1864.

605. John Clayton, Wolverhampton, Staffordshire, "Improvements in reverberatory and other furnaces for heating and melting iron and steel, and for other like purposes."

627. Robert Hanham Collyer, M.D., Ph.D., F.C.S., Beta House, Alpha Road, St. John's Wood, London, "An improved apparatus and process for the conversion of substances into material for the manufacture of paper and textile purposes."

632. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in the manufacture of soap."—A communication from Jean Baptiste Vasseur and Alexis Mahot, Paris.

635. Raymond Fletcher, Siddall's Road, Derby, "A new compound used for varnishing paperhangings and other articles."

674. Richard Archibald Brooman, Fleet Street, London, "Improvements in treating vegetable textile matters in separating filamentous matters therefrom, and the application of such matters to spinning, weaving, and dyeing."—A communication from Étienne Mallard, Florentin Bonneau, Adolphe Dumont, and Napoleon Jean Claude Canoby, Paris.

677. John Dauglish, M.D., Reading, Berkshire, "Improvements in the manufacture of aërated bread, and in apparatus to be used in this manufacture."

695. Frederick Tolhausen, Boulevart Magenta, Paris, "An improved process for preserving iron from corrosion, as produced by the influence of air and sea water."—A communication from Mr. Charles da Bussy, Avenue de Villars, Paris.—Petition recorded March 18, 1864.

Notices to Proceed.

584. James Preston Worrall, Ordsall, Lancashire, "Certain improvements in dyeing or colouring looped, cut pile, or raised textile fabrics composed of cotton and silk."—Petition recorded March 9, 1864.

2951. Davis Wilson Rea, Upper Thames Street, London, "Improvements in preserving animal and vegetable substances."—Petitions recorded November 29, 1863.

2963. George Parkin, Tryddyn, Flintshire, "Improvements in apparatus employed in the manufacture of paraffin and other like oils from shale, cannel, and other minerals."

2980. Thomas Gray, Mitcham, Surrey, "A new method of discharging colour from rags used for papermaking or other purposes, and in treating of vegetable fibres by such process."

2987. Heinrich Hirzel, Terminus Hotel, London Bridge, Southwark, Surrey, "Improvements in extracting essences and perfumes, and also oils and fats from matters containing them; also in bleaching and purifying oils and fats, and in apparatus employed therein."—Petitions recorded November 27, 1863.

3022. William Wilson, Manchester, "Improvements in generating gas for illuminating and other purposes, when made by passing atmospheric air over or through volatile oils, and treating such gas and the gas made from coal or cannel, after leaving the generators, so as to improve the heating and illuminating qualities thereof, and in the apparatus for effecting the same."

3029. Henry Holdrege, Irvington, New York, U.S., "Improvements in the process and manner of making gas for illuminating, heating, and other purposes, a part of which may also be applied to the production of metallic oxides."—A communication from William Henry Gwynne, New York, U.S.

CORRESPONDENCE.

Identity of Aconella with Narcotine.

To the Editor of the Chemical News.

Sir,—Having received, some time ago, from my friend, Mr. H. Draper, a specimen of the alkaloid discovered by Messrs. T. and H. Smith, of Edinburgh, in aconitum napellus, I thought it probable that some interesting results might be obtained by submitting a solution of the alkaloid to the action of polarised light. My object was to compare the change in the plane of polarisation of a ray, produced by transmission through a tube filled with this solution, with the change similarly produced by a solution of narcotine. This I was enabled to do with very great accuracy by means of an instrument which I described at a meeting of the Royal Irish Academy in January, 1863.

The experiment was made as follows:—

1. I dissolved 2·95 gr. of aconella in 1½ cubic inches of chloroform, and determined the rotatory power of the solution. I then made a solution of narcotine of the same strength, and measured its rotatory power in the same way, Had these powers differed from each other by the $\frac{1}{100}$th part, I could not have failed to see that they were unequal. No difference, however, could be detected.

2. Knowing the rotation produced by a solution of narcotine to be reversed by the addition of an acid, I was anxious to ascertain whether the same were true of a solution of aconella. In this experiment I was obliged to use as the solvent rectified spirit, inasmuch as the water contained in the dilute acid which I employed would have rendered the chloroform turbid. This made the experiment more difficult, narcotine being very sparingly soluble in spirit. In fact, I was with difficulty able to dissolve one grain of either substance in a cubic inch of cold spirit.

Having made two similar solutions of aconella and narcotine, I measured their rotatory powers before and after the addition of an acid. The results were as follows:—

a. In both cases the rotation was reversed.

b. Working by m, the ratio of the left-handed rotation produced by the solution of aconella to the right-handed rotation produced by the same solution when acidulated, and by m', the same ratio for narcotine, I found—

$$\frac{m}{m'} = 1{\cdot}02.$$

The acid used was hydrochloric, and was added in excess; the same quantity, of course, being used for each solution.

These results seem to leave little doubt of the identity of aconella with narcotine. I am, &c.

John H. Jellett,
Professor of Natural Philosophy to the
University of Dublin.

Trinity College, Dublin, April 26.

MISCELLANEOUS.

Chemistry at the College of Physicians.—It is related in the pages of one of our contemporaries, that at a recent meeting of the College of Physicians, Dr. Frederic Farre made the following statement in reference to the change of names of the chlorides of mercury in the British Pharmacopœia:—"When the chemical equivalent of mercury was 100, calomel was the chloride and corrosive sublimate the bichloride; but at the time of the preparation of the new Pharmacopœia, most distinguished chemists held that the chemical equivalent of mercury was 200; thus calomel became the subchloride and corrosive sublimate the chloride, and it was necessary to define them accordingly. He (Dr. Farre) believed that quite recently some chemists had reverted to the old notion that the chemical equivalent of mercury was only 100." As the meetings of the College are not officially reported, we have no means of knowing whether Dr. Farre's words were correctly taken down or not; but the statement is a series of mistakes from beginning to end. The facts are that when the equivalent of mercury was 200, calomel was the chloride and corrosive sublimate the bichloride, but at the time of the preparation of the British Pharmacopœia some chemists held that the chemical equivalent of mercury was 100; but now (April, 1864), some other chemists are reverting to the old notion that the chemical equivalent of mercury is 200. Thus Dr. Farre's statements ought all to be reversed in order to be accurate. By the established rules of chemical nomenclature, 200Hg. + 72Cl. must be the bichloride, or corrosive sublimate; and 200Hg. + 36Cl. must be the chloride, while if the chemical equivalent of mercury be 100, then 100Hg. + 36Cl. must be the chloride (still corrosive sublimate), and 200Hg. + 36Cl. (doubling the equivalent of mercury), must be the subchloride. We offer these remarks to the College of Physicians, and to the Chemical Fellows who were probably present at the meeting, as Dr. Alfred Taylor, Dr. Bence Jones, Dr. Garrod, Dr. Owen Rees, and others.—*Medical Circular.*

Royal Institution. — Monday, May 2, at two, Anniversary Meeting. Tuesday, May 3, at three, Professor Marshall, "On Animal Life." Thursday, May 4, at three, John Hullah, Esq., "On Music" (1600-1750). Friday, May 5, at eight, Professor Roscoe "On Indium, &c." Saturday, May 6, at three, Professor Frankland "On the Metallic Elements."

Why Bees Work in the Dark.—A lifetime might be spent in investigating the mysteries hidden in a bee-hive, and still half of the secrets would be undiscovered. The formation of the cell has long been a celebrated problem for the mathematician, whilst the changes which the honey undergoes offer at least an equal interest to the chemist. Every one knows what honey fresh from the comb is like. It is a clear yellow syrup, without a trace of solid sugar in it. Upon straining, however, it gradually assumes a crystalline appearance—it *candies*, as the saying is—and ultimately becomes a solid mass of sugar. It has not been suspected that this change was a photographic action. That the same agent which alters the molecular arrangement of the iodide of silver on the excited collodion plate, and determines the formations of camphor and iodine crystals in a bottle, causes the syrupy honey to assume a crystalline form. This, however, is the case. M. Scheibler has enclosed honey in stoppered flasks, some of which he has kept in perfect darkness, whilst others have been exposed to the light. The invariable result has been that the sunned portion rapidly crystallises, whilst that kept in the dark has remained perfectly liquid. We now see why bees are so careful to work in perfect darkness, and why they are so careful to obscure the glass windows which are sometimes placed in their hives. The existence of their young depends on the liquidity of the saccharine food presented to them, and if light were allowed access to this the syrup would gradually acquire a more or less solid consistency; it would seal up the cells, and in all probability prove fatal to the inmates of the hives.—*Chronicle of Optics,* "*Quarterly Journal of Science.*"

ANSWERS TO CORRESPONDENTS.

W. H. D.—Of Griffin, Bunhill-row, London.

Constant Reader.—Add any soluble sulphide to a salt of silver.

Book Received.—"The Prescriber's Pharmacopœia," by a Practising Physician.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Some Curious Properties of Oxide of Silver,
by M. BOETTGER.

M. BOETTGER has remarked that oxide of silver yields its oxygen to combustible matters quite as readily as does peroxide of lead PbO_2, which, on account of this property is very largely employed in the manufacture of chemical matches.

A very dry mixture of about two parts of oxide of silver and one of sulphur ignites by friction in a mortar or even between folds of paper. It makes no difference if the antimony compound is replaced by black sulphide of antimony, realgar, or piment.

The same thus occurs with amorphous phosphorus as with tannin. Gallic acid does not induce combustion.

A drop of phenic acid or creosote poured on very dry oxide of silver causes an instantaneous flame.

Flour of sulphur also ignites when triturated with this oxide; selenium the same.—*Journ. für Prakt. Chemie*, xc., 32.

Preparation of Suboxide of Copper, by M. R. BOETTGER.

SUBOXIDE of copper, says M. Boettger, is obtained in great perfection by the following process:—Dissolve in 2 parts of hot distilled water 1 part of crystallised sulphate of copper, 1½ part of tartrate of potash and soda and 2 parts of cane-sugar; when the solution is complete, and tartrate of copper formed, add 1½ part of caustic soda. By boiling the mixture, the suboxide of copper is gradually precipitated, losing its odour completely, as in saccharometric experiments.

The product is of a beautiful red colour, and after it is washed and dried will keep without alteration; before being dried the author advises its being washed in a little alcohol.—*Journ. für Prakt. Chemie*, xc., 163.

TECHNICAL CHEMISTRY.

*Preparation of Aniline Green.**

THE first notice of the reaction which produces aniline green was made by M. Eusebe, who dissolved crystallised aniline red in a mixture of alcohol with sulphuric, hydrochloric, or some other acid, and added a certain proportion of aldehyde or wood spirit. The solution becomes at first violet, and passes gradually to a bright blue. (The changes, however, are not constant.) Hyposulphite of soda is now added, and the mixture is heated, when the mixture assumes a beautiful green colour. The above process has many inconveniences; but the colour may be easily and quickly produced in the following way:—

150 grammes of crystallised sulphate of rosaniline are dissolved in 450 grammes of cold diluted sulphuric acid (three parts of acid to one of water). When the solution is complete 225 grammes of aldehyde are added, the mixture being stirred. The whole is now heated in a water-bath. From time to time a drop of the mixture is taken up with a stirring-rod and dropped into slightly acidulated water, and as soon as a deep green solution is obtained the reaction is stopped. The mixture is now poured into 30 litres of boiling water, and to this solution is gradually added 450 grammes of hyposulphite of soda, dissolved in the smallest possible quantity of water. The whole is now boiled for some minutes. All the green remains in the solution, which may be used to dye silk. The green is very beautiful, especially in artificial light, which distinguishes it from all other shades of the same colour.

PHARMACY, TOXICOLOGY, &c.

The Alkaloids of Aconite.

Aconella.—This substance, the optical properties of which have been investigated by Professor Jellett, was described by the Messrs. Smith in the *Pharmaceutical Journal* for January of this year. The mode in which they obtained it was as follows:—Juice of aconite root is evaporated to an extract, and then exhausted with spirit of wine; the spirit having been distilled off, the remainder is brought to an extract, which is also exhausted with spirit. Milk of lime is now added to the spirituous solution, and the liquor filtered. After filtration, sulphuric acid is added till there is no further precipitate. The liquor is again filtered, and the spirit distilled off. The watery portion left, after the separation of the green fatty matter, is filtered.

The liquor is strongly acid, and is now *nearly* neutralised with carbonate of soda. None of the aconitine will be thrown down until the liquor is alkaline.

On being left to itself for a day or two, the still slightly acid liquor deposits an abundant precipitate, which settles partly as a loose powder and partly in a crystalline state on the sides of the vessel. This precipitate furnishes *Aconella*, which can be obtained in snow-white crystalline tufts by repeated crystallisations from boiling alcohol and treatment with animal charcoal.

Aconella is very insoluble in water, but moderately soluble in boiling spirit and in ether. It is entirely consumed when burnt on platinum foil, and yields ammonia when treated with soda-lime. Tannin precipitates the oxalate, but not the muriate. It is precipitated by tincture of iodine, by corrosive sublimate, by terchloride of gold, and by bichloride of platinum. A distinguishing characteristic of the alkaloid is its tendency to crystallise. It appears to possess no poisonous qualities.

Besides the identity of optical properties mentioned by Professor Jellett last week, aconella presents so many other resemblances as to lead to the supposition that the two bodies are absolutely identical. Aconella, like narcotine, is tasteless in the solid state, but the solutions of both are very bitter. Both bodies are precipitated by tincture of iodine. Tannin precipitates the oxalate of both, but not the muriate. They have the same solubility in spirit, and the crystallisations of the two bodies are the exact counterparts of each other. Lastly, the equivalent of aconella, calculated from the platinum salt, appears to be 426·68, while that of narcotine is 427. The closeness of these numbers and the identity of the optical properties seem to leave no doubt that the same alkaloid is to be found in opium and the root of the Aconitum napellus.

Preparation of Aconitine.—The process for the preparation of aconitine, extracted from a thesis by M. Hottot, and given at page 200, vol. viii. of the CHEMICAL NEWS, has been somewhat modified by the author, who has adopted the following method of extracting the alkaloid:—Aconite root is digested in rectified spirit for eight days, and then percolated. The spirit is then distilled off over a water-bath, and the residue is treated with slaked lime, shaken occasionally, and filtered. The liquor is now precipitated with a slight excess of sulphuric acid, and evaporated to the consistence of a syrup. Two or three times its weight of water is added to the residue, which is then allowed to rest for some time, that the green oil may separate. This oil solidifies at 20° C., and may be removed from the surface, the last traces being separated by filtration through a wet filter. Ammonia is added to the filtrate, and the mixture heated to boiling; aconitine is thus precipitated in a compact mass which is easily separated from the liquor, but which contains a good deal of resin. The precipitated mass is washed, and then treated with *pure* ether, which dissolves the aconitine and leaves the greater part of the resin behind. The etherial solution is allowed to evaporate spontaneously, and the aconitine is further purified by repeated solution in sulphuric acid and careful precipitation with ammonia. At last the precipitate is washed and dried at a low temperature.

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* *Moniteur Scientifique*, April 15, 1864, p. 362.

Napellina.—Aconite root appears to contain two distinct substances, which possess in different degrees the physiological properties of aconitine. One is the amorphous and pulverulent aconitina, which M. Hottot could not obtain in crystals; the other is a body which can be procured in well-defined crystals, and which acts in the same way as aconitina, but with much less energy. For this body Mr. Morson, who first obtained it, has proposed the name *Napellina*.

The chemistry of napellina, so far as we know, has yet to be studied.

The reactions of aconitina are as follows:—The solid heated with strong sulphuric acid is first coloured yellow, then violet red; with a solution tannin gives an abundant precipitate; ioduretted iodide of potassium occasions a kermes-coloured precipitate. The latter solution is said to be the best antidote in cases of poisoning. Iodide of mercury and potassium gives a clotty, yellowish-white, and chloride of gold a yellow precipitate. Chloride of platinum gives no precipitate.

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.

Thursday, April 21, 1864.

Major-General Sabine, *President, in the Chair.*

A paper, by Professor F. A. Abel, F.R.S., "*On some Phenomena exhibited by Gun-cotton and Gunpowder under Special Conditions of Exposure to Heat.*"

(*Continued from page 209.*)

In describing the phenomena which accompany the ignition of gun-cotton in atmospheres of different rarefaction, it was pointed out that, at pressures varying from one to twenty-four inches of mercury, a pale yellow flame was observed, which increased in size with the pressure of the atmosphere; and that a flame of precisely the same character was produced in rarefied atmospheres of nitrogen. The same result was observed in atmospheres of carbonic acid, carbonic oxide, hydrogen, and coal-gas. In operating with pieces of gun-cotton-twist or thread of some length, instead of employing the material in loose tufts, the results obtained in the two last-named gases were very different from those observed in atmospheres of nitrogen, carbonic acid, and carbonic oxide. When ignited by means of a platinum wire (across which it was placed), in vessels filled with either of those two gases, and completely closed or open at one end, the piece of twist burned slowly and regularly, the combustion proceeding much more deliberately than if the same piece of gun-cotton had been ignited in the usual manner in air, and being accompanied by only a very small jet or tongue of pale yellow flame, which was thrown out in a line with the burning surface, when the gun-cotton was ignited. The same result was obtained in currents of those gases when passed through a long wide glass tube, along which the gun-cotton twist was laid, the one end being allowed to project some distance into the air. The projecting extremity being ignited, the character of the combustion of the gun-cotton was changed from the ordinary to the slow form as soon as the piece of twist had burned up to the opening of the tube through which the gas was passing. On repeating this form of experiment in currents of hydrogen and of coal-gas, the ignited gun-cotton burned in the slow manner only a very short distance inside the tube, the combustion ceasing altogether when not more than from half an inch to one inch of the twist had burned in the tube. The same result was observed when the current of gas was interrupted at the moment that the gun-cotton was inflamed. It was at first thought that this extinction of the combustion of gun-cotton by hydrogen and coal-gas might be caused by the very rapid abstraction of heat from the burning surface of gun-cotton, in consequence of the diffusive powers of those gases; but when the experiments were made in perfectly closed vessels, the piece of gun-cotton-twist being ignited by means of a platinum wire, the combustion also ceased almost instantaneously. These effects can, therefore, only be ascribed to the high cooling powers by connection of the gases in question.

The slow kind of combustion of gun-cotton, in the form of twist, which is determined by its ignition in currents or atmospheres of nitrogen, carbonic acid, &c., may also be obtained in a powerful current of atmospheric air, the thread of cotton being placed in a somewhat narrow glass tube. If, however, the air is at rest, or only passing slowly, the result is uncertain. In employing very narrow tubes, into which the gun-cotton fits pretty closely, the combustion passes over into the slow form when it reaches the opening of the tube, and occasionally it will continue to do so throughout the length of the tube. Sometimes, and especially when wider tubes are employed, the slow combustion will proceed only for a short distance, and then, in consequence of the ignition of a mixture of the combustible gases and air within the tube, the gun-cotton will explode with great violence, the tube being completely pulverised, and portions of unburnt cotton scattered by the explosion. If still wider tubes are employed, the cotton will flash into flame almost instantaneously throughout the tube directly the flame reaches the opening. In these cases the explosion is not violent; the tube escapes fracture sometimes, and at others is broken in a few places or torn open longitudinally, a slit being produced in the tube directly over the gun-cotton. By the employment of a screen of card-board, containing a perforation of the same diameter as that of the gun-cotton-twist, through which the latter was partially drawn, the alteration of the combustion of the material from the ordinary to the slow kind was found to be invariably effected.

These results indicate that if, even for the briefest space of time, the gases resulting from the first action of heat on gun-cotton, upon its ignition in open air, are impeded from completely enveloping the burning extremity of the gun-cotton-twist, their ignition is prevented; and as it is the comparatively high temperature produced by their combustion which effects the rapid and more complete combustion of the gun-cotton, the momentary extinction of the gases, and the continuous extraction of heat by them as they escape from the point of combustion, render it impossible for the gun-cotton to continue to burn otherwise than in the slow and imperfect manner, undergoing a transformation similar in character to destructive distillation.

These facts appear to be fully established by the following additional experimental results:—

With a loose twist of cotton it was found impossible to effect the described change in the nature of the combustion, because the gases do not simply burn at, or escape from, the extremity of the twisted cotton, but pass readily between the separated fibres of the material; and hence transmit the combustion at once, from particle to particle, and maintain the heat necessary for their own combustion.

If a piece of the compactly twisted gun-cotton, laid upon the table, be inflamed in the ordinary manner, and a jet of air be thrown against the flame, in a line with the piece of cotton, but in a direction opposite to that in which the flame is travelling, the combustion may readily be changed to the slow form, because the flame is prevented from enveloping the burning cotton, and thus becomes extinguished, as in the above experiment.

Conversely, if a gentle current of air be so directed against the gun-cotton, when undergoing the slow combustion, that it throws back upon the burning cotton the gases which are escaping, it will very speedily burst into the ordinary kind of combustion. Or, if a piece of the gun-cotton-twist, placed along a board, be made to burn in the imperfect manner, and the end of the board be then gradually raised, as soon as the material is brought into a nearly vertical position, the burning extremity being the lowest, it will burst into flame.

By applying to the extremity of a piece of the compact twist a heated body, the temperature of which may range from 135° C. even up to a red heat, provided the source of heat be not very large in proportion to the surface presented by the extremity of the gun-cotton, the latter may be ignited with certainty in such a manner that the slow form of combustion at once ensues, the heat applied being insufficient to inflame the gases produced by the decomposition of the gun-cotton. By allowing the gun-cotton thus ignited to burn in a moderately wide tube, closed at one end, the inflammable gases produced may be burned at the mouth of the tube while the gun-cotton is burning in the interior; or they may be ignited, and the gun-cotton consequently inflamed, by approaching a flame, or body heated to full redness, to the latter, in the direction in which they are escaping. It need hardly be stated that these results are regulated by the degree of compactness of the gun-cotton, the size of the twist, and the dimensions of the heated body.

The remarkable facility with which the nature of combustion of gun-cotton in air or other gases may be modified constitutes a most characteristic peculiarity of this substance as an explosive, which is not shared by gunpowder or explosive bodies of that class, and which renders it easily conceivable that this material is susceptible of application to the production of a comparatively great variety of mechanical effects, the nature of which is determined by slight modifications in its physical condition, or by what might at first sight appear very trifling variations of the conditions attending its employment.

There is little doubt that the products of decomposition of gun-cotton vary almost as greatly as the phenomena which attend its exposure to heat under the circumstances described in this paper. A few incidental observations, indicative of this variation, were made in the course of the experiments. Thus, in the instances of the most imperfect metamorphosis of gun-cotton, the products included a considerable proportion of a white vapour, slowly dissolved by water, as also small quantities of nitrous acid and a very large proportion of nitric oxide. The latter gas is invariably formed on the combustion of gun-cotton in air or other gases; but the quantity produced appears always to be much greater in instances of the imperfect or slow combustion of the material. The odour of the gases produced in combustions of that class is powerfully cyanic, and there is no difficulty in detecting cyanogen among the products. The author has already satisfied himself, by some qualitative experiments, of the very great difference existing between the results of the combustion of gun-cotton in open air, in partially confined spaces, and under conditions precisely similar to those which attend its employment for projectile or destructive purposes. He has, for example, confirmed the correctness of the statement made by Karolyi in his analytical account of the products of decomposition of gun-cotton, that no nitric oxide or higher oxide of nitrogen is eliminated upon the explosion of gun-cotton under considerable pressure, as in shells. Coupling this fact with the invariable production of nitric oxide, when gun-cotton is exploded in open air or partially confined spaces, there appears to be very strong reason for the belief that, just as the reduction of pressure determines a proportionately imperfect and complicated transformation of the gun-cotton upon its exposure to heat, the results of which are more or less essentially of an intermediate character, so, conversely, the greater the pressure, beyond the normal limits, under which gun-cotton is exploded, that is to say, the greater the pressure exerted by it, or the resistance presented at the first instant of its ignition, the more simple are the products of decomposition, and the greater are the physical effects attending its explosion, because of the greater energy with which the chemical change is effected.

A paper "*On Magnesium*," by Dr. T. L. Phipson, F.C.S.S., was then read. Iodine can be distilled off magnesium without attacking the metal in the least. In the same manner sulphur distils off magnesium without the metal being at all attacked. Heated for some time in a porcelain crucible with excess of anhydrous silica, magnesium burns vividly if the air has access, and a certain quantity of amorphous silicium is immediately formed. The metal is, therefore, capable of reducing silicic acid at a high temperature. The reason why potassium and sodium cannot effect this is simply because these metals are highly volatile, and fly off before the crucible has attained the proper temperature. Magnesium being much less volatile than the alkaline metals, takes oxygen from silica before volatilising. If the silicic acid be in excess, a silicate of magnesia is formed at the same time; if the metal is in excess, much siliciuret of magnesium is produced. The presence of the latter is immediately detected by throwing a little of the product into water acidulated with sulphuric acid, when the characteristic phosphoric odour of siliciuretted hydrogen is at once perceived. With boracic acid the phenomena are rather different: the acid melts and covers the metal, so that it does not inflame even when the crucible is left uncovered. A certain quantity of boron is soon liberated, and the product forms a greenish-black mass, which oxidises and becomes white in contact with water, and disengages no odoriferous gas in acidulated water. Dry carbonate of soda was heated with a little magnesium in a glass tube over a common spirit-lamp, and before the temperature had arrived at a red heat it was observed that carbon was liberated abundantly, and magnesia formed. A solution of caustic alkali or ammonia has little or no action upon magnesium in the cold. *Precipitation of Metallic Solutions.*—Magnesium precipitates nearly all the metals from their neutral solutions; when these are taken in the form of protosalts, even manganese, iron, and zinc are precipitated as black powders. Aluminium and uranium (and perhaps chrome) are only precipitated as oxides. *Alloys of Magnesium.*—I have examined only a few alloys of magnesium. Unlike zinc, magnesium will not unite with mercury at the ordinary temperature of the air. With tin eighty-five parts, and magnesium fifteen parts, I formed a very curious alloy of a beautiful lavender colour, very hard and brittle, easily pulverised, and decomposing water with considerable rapidity at ordinary temperatures. If the air has access during the formation of this alloy, the mixture takes fire; and if the crucible be then suddenly withdrawn from the lamp, the flame disappears, but a vivid phosphorescence ensues, and the unfused mass remains highly luminous for a considerable time. A white powdery mass, containing stannic acid and magnesia, is the result. [With platinum, according to Mr. Sonstadt, magnesium forms a fusible alloy; so that platinum crucibles can be easily perforated by heating magnesium in them.] Sodium and potassium unite with magnesium, and form very malleable alloys, which decompose water at the ordinary temperature. It is probable that an alloy of copper and magnesium, which I have not yet obtained, would differ from brass, not only in lightness, but by decomposing water at the ordinary temperature with more or less rapidity. *Uses.*—Magnesium will be found a useful metal wherever tenacity and lightness are required, and tarnish is of no consequence. The light furnished by combustion of the wire has already been utilised in photography at night. In the laboratory it will be found useful to effect decompositions which sodium and potassium cannot effect, on account of their greater volatility.

Thursday, April 28.

Major-General Sabine, *President, in the Chair.*

The following papers were read:—"*On the Magnetic Elements and their Secular Variations at Berlin,*" by Mr. A. Erman; "*On the Calculus of Symbols,*" by Mr. W. H. L. Russell; "*On the Action of Chlorine upon Methyl,*" by Mr. C. Schorlemmer. The last author exposed mixtures of chlorine and methyl to the action of diffused light, and observed the formation of drops of an oily liquid, the greater part of which evaporated at the temperature of 15°. By absorbing the hydrochloric acid produced with a little weak solution of soda, and then displacing the vapours by means of a warm solution of salt, condensing them as they escaped in a tube surrounded with freezing mixture, the author obtained a liquid which, on careful re-distillation yielded a product boiling between 11° and 12°, and which proved to be the chlorhydric ether of vinic alcohol. The residue boiled between 65° and 70°, and was the mono-chlorinated hydrochloric ether of vinic alcohol. Eight litres of methyl gave but eight grammes of the mixed chlorides, only a third part of what, according to theory, should have been found. The experiments prove that the first term of the series of alcoholic radicals is attacked by chlorine just in the same manner as its homologues ethyl-amyl, which gives chloride of heptyl, and amyl, which gives chloride of decatyl. The other terms of the series will no doubt submit to similar reactions. The author believes that by commencing with marsh gas, we may obtain not only all the terms of the series, but also produce synthetically the various mono- dia- and poly-atomic compounds, of which these hydrocarbons form the radicals.]

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, March 4, 1864.

Sir Henry Holland, *Bart., M.D., D.C.L., F.R.S., Vice-President, in the Chair.*

Professor G. G. Stokes, M.A., D.C.L., Sec. R.S., read a paper "*On the Discrimination of Organic Bodies by their Optical Properties.*"

(Continued from page 214.)

In order to be able to examine the peculiarities which a substance may possess in the mode in which it absorbs light, it is not essential that the substance should be in solution, and viewed by transmission. Thus, for example, when a pure spectrum is thrown on a sheet of paper painted with blood, the same bands are seen in the yellow and green region as when the light is transmitted through a solution of blood, and the spectrum thrown on a white screen. This indicates that the colour of such a paper is in fact due to absorption, although the paper is viewed by reflected light. Indeed, by far the greater number of coloured objects which are presented to us, such as green leaves, flowers, dyed cloths, though ordinarily seen by reflection, owe their colour to absorption. The light by which they are seen is, it is true, reflected, but it is not in reflection that the preferential selection of certain kinds of rays is made which causes the objects to appear coloured. Take, for example, red cloth. A small portion of the incident light is reflected at the outer surfaces of the fibres, and this portion, if it could be observed alone, would be found to be colourless. The greater part of the light penetrates into the fibres, when it immediately begins to suffer absorption on the part of the colouring matter. On arriving at the second surface of the fibre, a portion is reflected and a portion passes on, to be afterwards reflected from, or absorbed by, fibres lying more deeply. At each reflection the various kinds of light are reflected in as nearly as possible the same proportion; but in passing across the fibres in going and returning, they suffer very unequal absorption on the part of the colouring matter, so that in the aggregate of the light perceived the different components of white light are present in proportions widely different from those they bear to each other in white light itself, and the result is a vivid colouring.

There are, however, cases in which the different components of white light are reflected with different degrees of intensity, and the light becomes coloured by regular reflection. Gold and copper may be referred to as examples. In ordinary language we speak of a soldier's coat as red, and gold as yellow. But these colours belong to the substances in two totally different senses. In the former case the colouring is due to absorption; in the latter case to reflection. In the same sense, physically speaking, in which a soldier's coat is red, gold is not yellow, but blue or green. Such is, in fact, the colour of gold by transmission, and, therefore, as the result of absorption, as is seen in the case of gold leaf, which transmits a bluish green light, or of a weak solution of chloride of gold after the addition of protosulphate of iron, when the precipitated metallic gold remains in suspension in a finely-divided state, and causes the mixture to have a blue appearance when seen by transmitted light. In this case we see that while the substance copiously reflects and intensely absorbs rays of all kinds, it more copiously reflects the less refrangible rays, with respect to which it is more intensely opaque.

All metals are, however, highly opaque with regard to rays of all colours. But certain non-metallic substances present themselves which are at the same time intensely opaque with regard to one part of the spectrum, and only moderately opaque, or even pretty transparent, with regard to another part. Carthamime, murexide, platino-cyanide of magnesium may be mentioned as examples. Such substances reflect copiously, like a metal, those rays with respect to which they are intensely opaque, but more feebly, like a vitreous substance, those rays for which they are tolerably transparent. Hence, when white light is incident upon them, the regularly-reflected light is coloured, often vividly, those colours preponderating which the substance is capable of absorbing with intense avidity. But perhaps the most remarkable example known of the connexion between intense absorption and copious reflection occurs in the case of crystals of permanganate of potash. These crystals have a metallic appearance, and reflect a greenish light. They are too dark to allow the transmitted light to be examined; and even when they are pulverised, the fine purple powder they yield is too dark for convenient analysis of the transmitted light. But the splendid purple solution which they yield may be diluted at pleasure, and the analysis of the light transmitted by it presents no difficulty. The solution absorbs principally the green part of the spectrum; and when it is not too strong, or used in too great thickness, five bands of absorption, indicating minima of transparency, make their appearance [these were shown on a screen]. Now, when the green light reflected from the crystals is analysed by a prism, there are observed bright bands indicating maxima of reflecting power, corresponding in position to the dark bands in the light transmitted by the solution. The fifth bright band, indeed, can hardly, if at all, be made out, but the corresponding dark band is both less strong than the others and occurs in a fainter part of the spectrum. When the light is reflected at a suitable angle, and is analysed both by a Nicol's prism, placed with its principal section in the plane of incidence, and by an ordinary prism, the whole spectrum is reduced to the bands just mentioned. The Nicol's prism would under these circumstances extinguish the light reflected from a vitreous substance, and transmit a large part of the light reflected from a metal. Hence we see that as the refrangibility of the light gradually increases, the substance changes repeatedly, as regards the character of its reflecting power, from vitreous to metallic and back again, as the solution (and, therefore, it may be presumed, the substance itself) changes from moderately to intensely opaque, and conversely.

These considerations leave little doubt as to the chemical state of the copper present in a certain glass which was exhibited. This glass was coloured only in a very thin stratum on one face. By transmission it cut off a great deal of light, and was bluish. By reflection, especially when the colourless face was next the eye, it showed a reddish light visible in all directions, and having the appearance of coming from a fine precipitate, though it was not resolved by the microscope, at least with the power tried. It evidently came from a failure in an attempt to make one of the ordinary red glasses coloured by suboxide of copper, and the only question was as to the state in which the copper was present. It could not be oxide, for the quantity was too small to account for the blueness, and, in fact, the glass became sensibly colourless in the outer flame of a blow-pipe. Analysis of the transmitted light by the prism showed a small band of absorption in the place of the band seen in those copper-red glasses which are not too deep; and, therefore, a small portion of copper was present in the state of suboxide—*i.e.*, a silicate of that base. The rest was doubtless present as metallic copper, arising from over-reduction in the manufacture, and accordingly the blue colour, which would have been purer if the suboxide had been away, indicates the true colour of copper by transmitted light, quite in conformity with what we have seen in the case of gold. Hence, in both metals alike, the absorbing and the reflecting powers are, on the whole, greater for the less than for the more refrangible colours, the law of variation with refrangibility being of course somewhat different in the two cases.

Time would not permit of more than a very brief reference to the second property to which the speaker had referred as useful in tracing substances in impure solutions—that of fluorescence. The phenomenon of fluorescence consists in this, that certain substances, when placed in rays of one refrangibility, emit during the time of exposure compound light of lower refrangibility. When a pure fluorescent substance (as distinguished from a mixture) is examined in a pure spectrum, it is found that on passing from the extreme red to the violet and beyond the fluorescence commences at a certain point of the spectrum, varying from one substance to another, and continues from thence onwards, more or less strongly in one part or another, according to the particular substance. The colour of the fluorescent light is found to be nearly constant throughout the spectrum. Hence, when in a solution presented to us, and examined in a pure spectrum, we notice the fluorescence taking, as it were, a fresh start with a different colour, we may be pretty sure that we have to deal with a mixture of two fluorescent substances.

It might be inferred *à priori*, that fluorescence at any particular part of the spectrum would necessarily be accompanied by absorption, since otherwise there would be a creation of *vis viva*; and experience shows that rapid absorption (such as corresponds to a well-marked minimum of transparency indicated by a determinate band of absorption in the transmitted light) is accompanied by copious fluorescence. But experience has hitherto also shown, what could not have been predicted, and may not be universally true,* that conversely, absorption is accompanied, in the case of a fluorescent substance, by fluorescence.

From what precedes it follows that the colour of the fluorescent light of a solution, even when the incident light is white, or merely sifted by absorption, may be a useful character. To illustrate this, the electric light, after transmission through a deep-blue glass, was thrown on solutions in weak ammonia of two crystallised substances, æsculin and fraxin, obtained from the bark of the horse-chestnut, and of which the latter occurs also in the bark of the ash, in which, indeed, it was first discovered. Both solutions exhibited a lively fluorescence, but the colour was different, being blue in the case of æsculin and bluish-green in the case of fraxin. A purified solution obtained from the bark exhibits a fluorescence of an intermediate colour, which would suffice to show that æsculin would not alone account for the fluorescence of the solution of the bark.

When a substance possesses well-marked optical properties, it is in general nearly as easy to follow it in a mixture as in a pure solution. But if the problem which the observer proposes to himself be—Given a solution of unknown substances which presents well-marked characters with reference to different parts of the spectrum, to determine what portion of these characters belongs to one substance and what portion to another—it presents much greater difficulties. It was with reference to this subject that the second of the objects mentioned at the beginning of the discourse had been spoken of as that the attainment of which was by far the more difficult. The problem can in general be solved only by combining processes of chemical separation, especially fractional separation, with optical observation. When a solution has thus been sufficiently tested, those characters which are found always to accompany one another in, as nearly as can be judged, a constant proportion, may with the highest probability be regarded as belonging to one and the same substance. But while a combination of chemistry and optics is in general required, important information may sometimes be obtained from optics alone. This is especially the case when one at least of the substances present is at the same time fluorescent and peculiar in its mode of absorption.

To illustrate this the case of chlorophyll was referred to. An eminent French chemist, M. Fremy, proposed to himself to examine whether the green colour were due to a single substance, or to a mixture of a yellow and a blue substance. By the use of merely neutral bodies, he succeeded in separating chlorophyll into a yellow substance, and another which was green, but inclining a little to blue; but he could not in this way get further in the direction of blue. He conceived, however, that he had attained his object by dissolving chlorophyll in a mechanical mixture of ether and hydrochloric acid, the acid on separation showing a fine blue colour, while the ether was yellow. Now solutions of chlorophyll in neutral solvents, such as alcohol, ether, &c., show a lively fluorescence of a blood-red colour; and when the solution is examined in a pure spectrum, the red fluorescence, very copious in parts of the red, comparatively feeble in most of the green, is found to be very lively again in the blue and violet. Now a substance of a pure yellow colour, and exercising its absorption, therefore, as such substances do, on the more refrangible rays, would not show a pure red fluorescence. Either it would be non-fluorescent, or the fluorescence of its solution would contain (as experience shows) rays of refrangibilities reaching, or nearly so, to the part of the spectrum at which the fluorescence, and therefore the absorption, commences; and, therefore, the fluorescent light could not be pure red, as that of chlorophyll is found to be even in the blue and violet. The yellow substance separated by M. Fremy, by the aid of neutral reagents, is, in fact, non-fluorescent. Hence, the powerful red fluorescence in the blue and violet can only be attributed to the substance exercising the well-known powerful absorption in the red, which substance must, therefore, powerfully absorb the blue and violet. We can affirm, therefore, *à priori*, that if this substance were isolated it would NOT be blue, but only a somewhat bluer green. The blue solution obtained by M. Fremy owes, in fact, its colour to a product of decomposition, which when dissolved in neutral solvents is not blue at all, but of a nearly neutral tint, showing, however, in its spectrum extremely sharp bands of absorption.

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* Fluorescent substances, like others, doubtless absorb the invisible heat-rays lying beyond the extreme red, in a manner varying from one substance to another. Hence, if we include such rays in the incident spectrum, we have an example of absorption not accompanied by fluorescence. But the invisible heat rays differ from those of the visible spectrum (as there is every reason to believe) only in the way that the visible rays of one part of the spectrum differ from those of another, that is, by wave length, and consequently by refrangibility, which depends on wave length. Hence, it is not improbable that substances may be discovered which absorb the visible rays in some parts of the spectrum less refrangible than that at which the fluorescence commences; and *mixtures* possessing this property may be made at pleasure. Nevertheless, the speaker has not yet met with a pure fluorescent substance which exhibits this phenomenon.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture IX.—*Thursday, January 21, 1864.*

(Continued from page 186.)

We proceed to-day with the examination of the constituents of sea-water. The first of those which remain to be considered is boron, which exists in boracic acid. I informed you in the last lecture that Forchammer sought in vain for a long time to find boron directly in sea-water. Boracic acid salts may be discovered in dried sea-mud in closed natural basins. They have been, in fact, so discovered, as at Stassfurth, near Magdeburg. A very fine collection of specimens of this kind appeared in the Zollverein department of the Exhibition of last year, and we have a series of them in the museum. Ten pounds of sea-water from the sound of Copenhagen was evaporated to dryness; the residue was then melted in a platinum crucible, and washed well with water. This residue was seen under the microscope to be crystalline throughout. It consisted for the most part of gypsum, that is, a salt of lime. This was dissolved out with water, and the washing was continued until no further sulphuric acid could be detected. There are some very curious and interesting points connected with this experiment of Forchammer; in the residue he found small regular octahedral crystals consisting of periclase, that is, pure crystallised magnesia. The residue was now digested for some twenty-four hours with sal-ammoniac—chloride of ammonium. The octahedral crystals disappeared, and in the residue were found regular hexagonal prisms of apatite—phosphate of lime, and also some oblique prismatic crystals. Both were dissolved in hydrochloric acid, and decomposed by sulphuric acid, and then evaporated in a steam bath. By the solvent action of water containing 60 per cent. of alcohol, a solution was obtained which gave to turmeric the characteristic reaction of boracic acid, and the spirit burned green at the edges. We will show you this experiment, which is usually resorted to in order to detect the presence of boracic acid. Here, in this vessel, is some asbestos moistened with spirit in which boracic acid is dissolved. Upon gently heating the vessel, and igniting the spirit, the green flame of boracic acid will be produced.

By the evaporation of the spirit, small scales were actually obtained, having the appearance of boracic acid. After the solution of the borax and the phosphates contained in the residue of sea water, crystals remained undissolved, which, under the microscope, appeared to be pointed regular six-sided pyramids. They obstinately withstood the action of acids, and were found to be composed of alumina and peroxide of iron. No further investigation has been since made concerning the precise constitution of this crystalline body.

I think you will admit that it is an interesting fact that simply by the evaporation of sea water in this way, and the fusion of the residue, we should be able to obtain several distinct minerals; and I think you will also admit that the proof here advanced of the presence of boracic acid in sea-water is clear and conclusive.

I may say incidentally that this periclase—oxide of magnesium, or magnesia crystals—may be obtained by the prolonged action of lime on borate of magnesia in a porcelain furnace. It requires a high temperature, and long exposure thereto, to produce it. It has also been produced crystallised by the action of hydrochloric acid gas on magnesia, and also by the action of steam upon chloride of magnesium. That is an action not at all unlikely to occur in nature. The apatite has been produced crystallised by fusing a mixture of phosphate of soda, fluoride of calcium, and an excess of chloride of calcium; or by fusing a mixture of common amorphous phosphate of lime and chloride of sodium—common salt; or by fusing phosphate of lime with fluoride and chloride of calcium in a vessel of carbon; or by heating phosphate of lime in contact with chloride of calcium at a temperature of 250° Centigrade.

The next constituent we have to consider is a very interesting one, and that is silver. Careful experiments have been made to ascertain whether sea water contains silver or not. It would be impossible to bring before you all the details; but the result appears to be conclusive. Silver is there. It must be there, in fact. The chloride of silver, which is so insoluble of itself, is very sensibly soluble in aqueous solutions containing chlorides dissolved. It has been sought for on the metal of ships. It is exceedingly likely that we should find it on ships coated with copper, or with Muntz's metal, which is a variety of brass, consisting of copper and zinc. These metals, in contact with chloride of silver dissolved in sea water, by virtue of the presence of other chlorides, would decompose the chloride of silver, and we should have the silver thrown down upon the surface of the metal. Experiments of this nature, as well as others, have been made repeatedly, and seem to establish conclusively the fact of the presence of silver in sea water. Forchammer found it in the carbonate of lime of certain of the lower marine animals. I mentioned to you on the last occasion a singular fact concerning the presence of silver in some of our ironstones in South Wales.

Gold has been sought for in sea water, but not yet clearly detected. Many years ago we were engaged here in making some experiments concerning the extraction of gold and silver from lead. It occurred to us as possible that the sheathing metals of ships which have been long at sea might contain gold upon the surface. We examined some copper sheathing carefully and found gold thereon, but unfortunately this result was inconclusive, because we had not previously ascertained the absence of gold from copper, and I am quite sure it is much more frequently present in that metal than is generally supposed. The experiment was therefore entirely vitiated on that account. The presence of gold in sea water is a point well worthy of further search.

Copper has not been directly detected in sea water, but it has been found—and this is equally conclusive—in the carbonate of lime of sea animals and in the ashes of sea plants.

Lead has not been found directly, but has been discovered in the same way as copper in the same materials, but in much larger quantity. By the action of sea water upon lead chloride of lead is formed, which I have seen, in one case at all events, beautifully crystallised. This is a specimen which has been long immersed in sea water. I am now speaking of some years ago. It is covered with beautiful crystals of chloride of lead.

Zinc has not been immediately found in sea water, but it has been detected in comparatively considerable quantity by Forchammer in marine plants, especially in the *zostera marina* and also in the *fucus vesiculosus*, which is very common about our coasts.

The metals cobalt and nickel, which are so commonly associated in nature, have been sought for and found in the ashes of sea plants, but not directly in sea water.

Iron may be detected directly in the residue of the evaporation of sea water, and also in the ashes of sea plants, and in the secreted lime of sea animals.

Manganese is found along with iron in the ashes of the *zostera marina*, and especially in plants collected in the middle of summer, the ashes of which contained, according to Forchammer, so much oxide of manganese that the odour of chlorine was strongly developed when hydrochloric acid was poured upon them. The ashes of the *zostera marina* contain a comparatively very large proportion of the protoxide of manganese. It is said that the amount was even so much as 4 per cent.

Aluminium, after a good deal of trouble, was found by Forchammer, as I stated a short time ago, in the fused residue of the evaporated sea water from the sound of Copenhagen.

Magnesium is also a constituent of sea water. Magnesia is a very prominent compound in sea water. A very good way of estimating the proportions of the constituents of sea water is to take the chief constituent, which is chlorine, as a standard, and to estimate the quantity of the other bodies contained in it in relation to chlorine. We will take that standard as 100, as Forchammer has done. The relation of the magnesia to the chlorine is, by weight, 11,077. The presence of such a large quantity is explained by the fact that few chemical or other reactions occur in sea water to remove the magnesia; whereas we know, in reference to lime, that when lime has fallen into sea water it is very speedily appropriated by sea animals, and is very rapidly removed from the water. This is not the case with magnesia. Magnesia occurs in sea plants and animals, and in *serpula filigrana* Forchammer found as much as 13·49 per cent. of carbonate of magnesia.

Calcium is the next constituent to which I shall refer. Lime exists in sea water in very small quantity in combination with carbonic acid; in greater proportion with phosphoric acid and fluorine; and in greatest proportion of all with sulphuric acid. You see, then, that lime exists in several states of combination in sea water. Its combination with sulphuric acid is by far the most important for us to consider. Its relation to chlorine is 2·96 to 100. You see how much smaller the proportion of lime is than that of the magnesia compared with our standard of chlorine.

Barium is found always along with strontium. The sulphate of strontia was directly discovered by Forchammer in the evaporated residue of sea water, especially in the deposit of steam boilers. It was also met with in *fucus vesiculosus*, and along with it it was baryta. The occurrence of strontia along with baryta in sea water is a very curious point.

Sodium, as we all know, is, of course, abundant in sea water in the form of chloride of sodium or common salt.

Potassium is also present, but in much smaller quantity than sodium.

Both lithium and arsenic are reported to have been discovered in sea water.

The total average amount of saline matter in water of the ocean is 1·811 per cent. Or, perhaps, the better way of taking it will be the quantity in the thousand parts, which will be 18·11. The maximum of saline matter was 18·14. It occurred near the equator, between Africa, Borneo, and Malacca. The minimum of saline residue was 18·06 in the thousand parts. It occurred between the Aleutian and Society Islands.

We will now direct attention to the relations between the chief constituents of sea-water, taking, as I said just now, 100 parts of chlorine as the standard. Sulphuric acid presents the relation of 11·89 to that standard; lime, 2·96; and magnesia, 11·07. This method of comparison with the chief constituent is, I think, a very instructive way of representing the quantity of the substances in sea-water. The relations I have given you apply to the water of the main—to ocean water. In the Baltic the following relation obtains:—Sulphuric acid, 12·77 (this is a larger proportion than in the water of the ocean); lime, 3.59; magnesia, 11·89. The water of the Kattegat and the Sound contains:—Sulphuric acid, 11·94; lime, 3·29; magnesia, 10·86. These differences are sensible when we come to estimate them in respect to a large amount of water.

	Sulphuric Acid.	Lime.	Magnesia.
In the North Sea the quantities are	12·05	2·87	11·25
„ Mediterranean „ „	11·82	3·08	10·90

The differences now become very appreciable. The saline matter in sea-water decreases, in general, as one would expect, near the coast. It is subject to much variation, which depends greatly upon the flow of fresh water from the rivers. On the west coast of South America, where little or no water flows in this way from the land, this variation does not obtain. Between the water of the Baltic, which drains a great part of the north and east of Europe, and the water of the Mediterranean, the difference is very great. The Baltic contains proportionately less saline matter; and the water of the Mediterranean between the Straits of Gibraltar and the Grecian Archipelago, contains, on the average, 37·936 parts in the thousand of saline matter—that is, 3·7936 per cent. This is explained by the deficient supply of fresh water, and by the great evaporation caused by the hot, dry winds from Africa. In the corresponding part of the Atlantic Ocean, the proportion is 35·946 in the thousand; and in the tropical part of the Atlantic Ocean, between 30 degrees south of the equator, and 30 degrees north of the equator, the mean proportion is 36·321 in the thousand. In the Mediterranean, between the Island of Candia and the African coast, the proportion is 39·257—a very sensible difference—about three parts in the thousand. The double stream in the Strait of Gibraltar has, of course, long been known. The specifically lighter water of the Atlantic forms the upper current flowing in, and the specifically heavier water of the Mediterranean forms the deep water flowing out. In the Baltic there are double currents, but the reverse is true in respect to the direction of those currents. As a rule, the upper current flows out of the Baltic into the Kattegat, and the lower current from the Kattegat into the Baltic. The cause appears to be similar to that of the currents in the Mediterranean—the difference of the specific gravity between the water of the Baltic and that of the ocean, or that is one cause, at all events; but we find that the specific gravity of the two currents is exactly the reverse of what I stated with regard to the Mediterranean. I will give you some of the observations which have been made by Forchammer on this interesting point. In 1846, from April 27 to September 11, 19 observations were made on the deep current, and 134 on the upper current. In these 134 days the upper current came during 24 days from the north, and it contained on the average 15·994 in a thousand of solid residue. In 86 days, during which it came from the south, it contained on an average 13.342 of saline matter in a thousand. The ground current of the sound was observed once in every week, and it contained on the average 19·002 of saline matter in a thousand. You see that that is a great difference. The bottom current is sometimes very strong, and this is said to explain a phenomenon often observed—namely, that vessels of deep draught of water go against wind and the upper current, whilst vessels of less draught in vain attempt to bear up against those forces, the deep draught vessels reaching the lower current, which is very strong, and carries them against the upper current and the wind. In March, 1860, the temperature of the bottom current was 2·6 Centigrade at a depth of 108 feet, and that of the upper current 1·6 Centigrade. In the summer no difference of temperature was found between the two currents. The average proportion of saline matter in the water of the Polar currents from Baffin's Bay and Davis's Straits was 33·176 in the thousand. The quantity in the South Polar Ocean was 27·285. In the Atlantic Ocean, between the equator and the 30th degree of north latitude, it was 36·169. I give you simply a few illustrations.

The average composition of the solid ingredients of sea water at the surface, exclusive of the North Sea, the Baltic, the Mediterranean, and the Black Sea—that is, the water of the ocean generally—may be taken at 34·304. Then the chlorine will be 18·945; the sulphuric acid, 2·253; the lime, 0·561; and the magnesia, 2·096. Those are the most important ingredients. Taking the relations, according to our first plan of stating the proportions—that is, representing chlorine as 100—sulphuric acid will be 11·89; lime, 2·96; and magnesia, 1·07. This may be regarded as the relation existing between the chief constituents of the solid residue of general ocean water, exclusive of those seas which I have mentioned, and where certain local peculiarities obtain.

Much might be said with regard to the interesting fact of the variation in the proportion of saline matter at different depths, but I will give you a few observations only upon that subject.

The water of Baffin's Bay, taken from the surface, contained 33·594 of saline matter per thousand, and at a depth of 420 feet it contained 33·607, a trifle more than the water of the surface. At 59 deg. 45 min. north latitude, and 39 deg. 4 min. west longitude, surface water contained 35·067 per thousand, and at a depth of 270 feet the water contained 35·963, a sensibly larger amount. At 59 deg. 50 min. north latitude, and 7 deg. 52 min. west longitude, surface water contained 35·576; and at 270 feet deep the quantity was 35·462, a slight variation in the reverse direction, the surface water in the other instances I have mentioned containing a little less than the deep water. In the middle of the Atlantic ocean, surface water contained 36·196 of saline matter; and water from the greatest depth, I believe, at which water has yet been taken for examination, namely, 11,100 feet, contained 35·170. That is an interesting point—more than one part in a thousand less. I might give you a great number of further illustrations, but I should only weary you by detaining you for that purpose.

There are some curious points concerning the differences of condition in the deposition of saline matter from sea water. When a portion of the sea is separated from the rest of the ocean by a change of level, and more water is removed by evaporation than is supplied by rivers flowing into it, and no water flows out, there must, of course, be a gradual concentration of the water, and finally the deposition of all the salts. When under similar conditions there is an outflow, but less in amount than the inflow, salts must in course of time be deposited, but in this case the least soluble will be deposited—such as gypsum and chloride of sodium—and the less soluble will be washed away. Some curious observations were made some years ago by Balard, the discoverer of bromine; and upon these observations he attempted to establish certain important operations. I will give you the main results, as they really have an important geological bearing, and show how one salt after another may be deposited by spontaneous evaporation at given degrees of density.

When the water of the Mediterranean was concentrated by spontaneous evaporation to the specific gravity of 1·27, common salt only was deposited. The mother-liquor or the bittern by further concentration by spontaneous evaporation, first deposits, as its specific gravity rises to 1·32, a mixed salt consisting of about 40 parts of sulphate of magnesia, or Epsom salts, and 60 of common salt; or if the temperature falls to 6 or 7 degrees centigrade—that is, to 43 or 45 degrees Fahrenheit—the bittern of the specific gravity of 1·32 deposits sulphate of magnesia nearly pure. About 90 kilogrammes—that is, nearly 200 lbs. weight, were obtained from a cubic metre of water of this specific gravity. The bittern concentrated to 1·345 specific gravity by spontaneous evaporation, after the deposition of the magnesian salt, deposits a double chloride of potassium and magnesium. When this is dissolved in a small quantity of hot water, the chloride of potassium crystallises nearly pure on cooling. The bittern of the specific gravity of 1·345 contains much chloride of magnesium. The greater part of the sulphate in sea-water separates as sulphate of soda when the liquid is concentrated from the specific gravity of 1·152 to 1·2, if cooled down to 4 or 5 degrees below zero centigrade—that is, 23 or 25 Fahrenheit. Those are, no doubt, very curious points, capable of application by geologists in explaining those remarkable saliferous deposits which we find in different parts of the earth. I might refer to an experiment made some years ago, in which salts were formed upon this principle. There were specimens in the Exhibition of 1862, and there are fine specimens in this museum. At Stassfurth, saline deposits have been found in which one salt after another has been produced, no doubt by spontaneous evaporation. I will just call your attention to them incidentally. There is a very curious one called carnalite, consisting of one part of chloride of potassium, two of chloride of magnesium, and twelve of water. There is another called kisserite, which is a sulphate of magnesia containing water—one atom only. Then there is the salt called stathfurthite, which is a compound of borate of magnesia and chloride of magnesium. All these occur in these curious deposits, which were no doubt produced by evaporation under special conditions, such as those to which I have drawn your attention.

(To be continued.)

ACADEMY OF SCIENCES.

April 25.

M. Peligot communicated a memoir "*On the Organic Matters contained in Water.*" The author's experiments were made with the waters supplied to Paris, and the results are mainly interesting to the Parisians; but one or two things are worthy of notice here. M. Peligot points out that certain metallic salts, perchloride of iron among them, precipitate organic matters, and act as powerful disinfectants. The action of the iron salt is most marked and rapid; but the proportion of the salt added must be carefully adjusted to the amount of mineral matter contained in the water; for in the presence of a great excess no precipitate will be formed. The deposit formed is a compound of ferric hydrate and oxide of iron with organic matter resembling the crenic and apocrenic acids of Berzelius. We may quote the method by which the author separated urea from sewer water. He evaporated the water to dryness, treated the residue with absolute alcohol, and evaporated the alcoholic solution to dryness. The latter residue he then dialysed, evaporated the diffusate, added nitric acid to the residue, and so obtained crystals of nitrate of urea. M. Peligot remarks that we very much overestimate the rate at which organic matters in solution decompose; and his own belief accords with that of Vauquelin, who showed forty years ago that urea broke up very slowly in water.

M. Robinet read a memoir "*On the Means of Increasing the Salubrity of Large Towns.*" The author's suggestion is one which was made here long ago, namely, to ventilate drains and sewers by means of openings in communication with furnaces and high chimneys.

M. Th. Harnitz Harnitsky presented a memoir "*On the Synthesis of Chloride of Benzoyl and Benzoic Acid.*" When benzoic acid is distilled with an excess of caustic alkali, it breaks up into carbonic acid and benzine. The author has succeeded in effecting the inverse reaction. He passed oxychloride of carbon and the vapour of benzine into a retort heated and exposed to sunlight, and collected the products. After the separation of unaltered benzine from these, he obtained a liquid boiling at 198° which had a penetrating odour and irritated the eyes and lungs, it burnt with a luminous very smoky flame, sank in water, and in the water gradually formed a crystalline mass. These crystals proved to be benzoic acid, and the liquid from which they separated was chloride of benzoyl. The author is endeavouring to obtain the homologues of benzoic acid by similar means.

M. A. Lallemand presented a note "*On the Cyanides of Copper and some of their Combinations.*" The note relates principally to the double cyanides of copper and alkalies.

M. Bobierre communicates some "*Researches on the Chemical Composition of Rain-water Collected at Different Heights.*" The author's experiments were made at Nantes, where he collected the water on the observatory tower, and near the ground. The results of the examination of these waters are curious and interesting. They show that the rain-water collected in large towns varies much in composition. We can only find space for the mean results. The ammonia found in the water near the ground was always greatly in excess of that in the water collected on the tower. A little more nitric acid was present in the water collected above. The chlorine was about the same in both. The author remarks that a chemical examination of rain-water is an easy way of proving the vitiation of the atmosphere.

M. Blondlot sent a note "*On the Purification of Arsenical Sulphuric Acid.*" The author objects to the process of MM. Bussey and Buignet which we lately published, that some nitric acid may be left in the sulphuric, and that sulphate of ammonia might reduce arsenic acid to arsenious which would pass over as before. He therefore recommends that peroxides of manganese should be used to oxidise the arsenious acid. The way he proceeds is as follows:—Peroxide of manganese is added in the proportion of four to five grammes to the kilogramme of sulphuric acid, and the mixture heated to boiling in a porcelain dish, stirring all the time. The mixture is allowed to cool, and is then transferred to a retort and distilled. M. Blondlot has distilled to dryness acid so treated, and never found a trace of arsenic in the distillate.

NOTICES OF BOOKS.

The Prescriber's Pharmacopœia: Containing all the Medicines in the British Pharmacopœia of 1864, &c., &c. By a PRACTISING PHYSICIAN. Fifth Edition. London: Churchill and Sons, 1864.

In this book the remedies in the Pharmacopœia are classed according to their properties, *e.g.*, as acids (antalkalines), alkalies (antacids), astringents, errhines, sialagogues, masticatories, &c. We have often wondered what sort of prescribers can want a book of this kind, and imagined the hopeless bewilderment of one who referred to it. The only useful thing we can see in the work is the doses appended to each medicine, and it would have been much more rational to have given the articles in their alphabetical order with simply the dose added.

We give a specimen of the contents, that our readers may form their own opinion. Under the head vegetable tonics we find,—

"Decoctum cinchonæ flavæ.

"Comp. cinchona flava, 1 oz.; water, 20 oz. (boil). Dose, fl. oz. fl. oz. 2.

"Incomp. lime water, tartar emetic, sulphate of iron."

That is the sort of information which a "Practising Physician" thinks will be useful to his professional brethren; and we need not waste our space in showing the deficiencies of it.

Botany for Novices: a Short Outline of the Natural System of the Classification of Plants. By L. E. B. London: Whittaker and Co. 1864.

This is a book, the execution of which we can warmly praise as far as it goes. It is, however, a book for novices, being simply an attempt to explain the principles of the natural system, and therefore dealing but with the simplest rudiments of botanical science. But though unpretending, it has the merit of great clearness, and the careful student will easily understand, and be able to determine, the class and subclass to which any flower he may examine belongs, which, though not going very far in the natural system, is necessarily the beginning of botanical study. We can heartily recommend the book to those for whom it has been written, namely, "those who have no previous acquaintance with botanical science," and join in the hope of the writer, "that it may introduce its readers to a more extended study of the subject."

The Economical Use of Fuel, and the Prevention of Smoke in Domestic Fireplaces; with observations on the Patent Laws. By FREDERICK EDWARDS, JUN. London: Hardwicke. 1864.

Last year Sir William Armstrong rather frightened the nation with his idea of the rapid exhaustion of our coal-fields, and the waste of coal in our domestic fireplaces. The public mind soon quieted itself again. People said to themselves "The coal will last my time," and nobody thought of pulling down his house, and building another with narrower chimneys, and supplied with grates upon the most approved principles. So the waste still goes on, and increases with every house built.

The author of this book does well to recall public attention to the subject; but we do not expect his present effort will be very successful. The book seems to us a mistake. A very interesting little work might have been written on the principles involved in the economical use of fuel in the warming of our dwellings, and such a work we have no doubt would have met with a success which this notice of several inventions for producing a smokeless fire will hardly command. We advise the author to reconsider the matter, and to give us simply an account of the firegrate he recommends, and the principles involved in its construction and use, so that the public and builders may understand the subject. It is a matter well deserving attention, for it seems that more than a million a year goes up our chimneys in the form of smoke, only to pollute the atmosphere and begrime the neighbourhood.

At the conclusion of his book the author makes an onslaught on the patent laws, and advocates their entire abolition on grounds which, if we understand them, appear to us altogether insufficient. The patent laws are, no doubt, greatly abused, and require revision. But, except by a similar law, we do not see how a real inventor is to be secured a proper reward. In any reform of the law the object should be to guard against the public being imposed upon by sham inventors, who strive to appropriate well-known contrivances, such as the double window pane alluded to here by Mr. Edwards. The author seems to suppose that all the advantage a patent offers might be secured by a public exhibition of useful inventions, which many may think will afford excellent opportunities for copying the invention, without rewarding the inventor. It will be found useless, however, to argue against patents in face of the enormous fortunes which are known to be occasionally made by their means.

Annales de Chimie et de Physique, March, 1864.

This number, which we have just received, contains a learned paper, by M. Cazin, "*On the Valuation of Electro-dynamic Action in Unites of Weight*," which will no doubt receive much attention. M. Béchamp publishes a paper "*On the Existence of Several Odoriferous and Homologous Fatty Acids in the Fruit of the Gingko Biloba.*" He has found therein formic, acetic, propionic, butyric, valeric, caproic, and caprylic acids, butyric, acetic, and caproic predominating. A valuable paper "*On the Mutual Action of Oxides of Mercury on Salts with an Alkaline or Alkaline-Earthy Base*" we shall translate at length. The remainder of the number is made up of papers by M. Berthelot and others, which have already appeared in abstract in the Chemical News, but to which we may return when the learned societies now necessarily occupying much of our space adjourn for the vacation.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

Communicated by Mr. Vaughan, Patent Agent, 15, Southampton Buildings, Chancery Lane, W.C.

286. William Watson and William Henry Watson, Leeds, York, "Improvements in the manufacture of blue colour for dyeing and other purposes."—Petition recorded February 3, 1864.

320. Marie Celeste de Casteras Sinibaldi, Greenwich, Kent, "Improvements in the manufacture of plates, tubes, cylinders, and other articles, and for covering or coating the same with copper, brass, or other metals."—Petition recorded February 6, 1864.

341. Brereton Todd, Falmouth, Cornwall, "Improvements in compositions to be used to prevent the oxidation of iron, the fouling of ships' bottoms, and other submerged things, and also for preserving wood from decay and worms."—Petition recorded February 9, 1864.

351. Marie Celeste de Casteras Sinibaldi, Greenwich, Kent, "Improvements in coating with copper, brass, or other metals the surfaces of ships and other structures of iron or steel."—Petition recorded February 10, 1864.

355. Thomas Vincent Lee, Macclesfield, Chester, "Improvements in the construction of kilns or retorts for coking, and for apparatus connected therewith for collecting the products of distillation through the agency of hydro-caloric or superheated steam; these appliances being applicable to making wood charcoal, and collecting pyroligneous acid during the process."—Petition recorded February 11, 1864.

603. Thomas Boyle, Gray's Inn Road, London, "An improved air and smoke valve."—Petition recorded March 10, 1864.

634. John Platt and William Richardson, Oldham, Lancashire, "Improvements in machinery or apparatus for breaking up or pulverising clay for the manufacture of bricks or other such articles, or for breaking up or pulverising other materials."—Petition recorded March 12, 1864.

668. James Carrick, George Square, Glasgow, N.B., "Improvements in apparatus for inhaling, breathing, and respiratory purposes."—Petition recorded March 16, 1864.

696. James Burrell, Back Church Lane, Whitechapel, London, "Improved apparatus to be used in combination with marine steam-boilers as a self-acting scum or brine cock and feed cock, which apparatus may also be used as a salinometer and water gauge."

698. George Kershaw, Park Street, Camden Town, London, "Improvements in macerating vessels."—Petitions recorded March 18, 1864.

699. Charles Heywood, Manchester, Lancashire, "An improved method and means of removing 'scum' or floating particles from the surface of water or other liquids."

700. David Jones, Birmingham, Warwick, "Improvements in sugar funnels or moulds."—A communication from Simon Labayen, Matanzas, Cuba.—Petitions recorded March 19, 1864.

713. John Morgan, Stephen's Green, Dublin, "Improvements in the preservation of animal and vegetable substances, and in the fluids to be employed therein."

716. George Firmin and Cornelius Firmin, Henley Rettory, near Ipswich, Suffolk, "Improvements in heating the contents of vats or tanks and other receptacles in steeping flax and hemp."—Petitions recorded March 21, 1864.

728. François Louis Roux, Abingdon Street, Westminster, "An improved plastic compound for the protection of metallic and non-metallic surfaces from the action of water, air, and other causes of deterioration."—Petition recorded March 23, 1864.

745. Charles Garton, Bristol, and Thomas Hill, Southampton, "Improvements in mashing apparatus."

746. Samuel Bark and Thomas Atwood, Smethwick, Stafford, and James David Robinson, Birmingham, Warwick, "Certain improvements in slides for gaseliers, as also in the means of regulating or stopping the flow of gas, parts of which improvements are also applicable to chandeliers where oil, camphine, or other inflammable liquids are used for illumination."—Petitions recorded March 24, 1864.

754. Richard Archibald Brooman, Fleet Street, London, "An improved method of, and improved apparatus for, revivifying animal black."—A communication from Jean Baptiste Felix Trolliet, Lyons, France.—Petition recorded March 26, 1864.

769. John Lightfoot, Accrington, Lancashire, "Improvements in dyeing and printing textile fabrics and yarns, and in fixing more permanently certain mordants thereon."

770. Michael Henry, Fleet Street, London, "Improvements in apparatus for supplying air to persons employed under water or in places where noxious gas, air, or vapour prevails."—A communication from Benoist Rouquayrol, Paris, France.—Petitions recorded March 28, 1864.

773. James Robbins, Howley Street, Lambeth, "New improved methods of, and apparatus for, treating various liquid and solid substances for the production of artificial liquid manures, for separating oils and other liquids from solids, and preparing or treating the solid ingredients for dry manures; the said apparatus, or parts thereof, being applicable for filtering, decanting, carbonising, pumping, drying, evaporating, and digesting generally."

775. Isaac Mark Evans, Ruabon, Denbigh, "Improvements in blasting for mining and other purposes, applicable also to discharging projectiles, and in the apparatus used in connexion therewith."

782. Arthur Heald, Sabden Whalley, Lancashire, "An improved composition for sizing yarns and threads."

783. Charles Doughty, Lincoln, "Improvements in treating a product obtained in refining the oil of cotton seeds."—Petitions recorded March 29, 1864.

786. Joseph Lang, Bolton-le-Moors, Lancashire, "Certain improvements in the ventilation of mines."

790. Thomas Waller, Fish Street Hill, London, "Improvements in apparatus for heating air, and in valves for admitting heated and cold air, and regulating the supply thereof."

791. Thomas James Smith, Twickenham, Middlesex, "Improvements in the purification, distillation, rectification, evaporation, condensation, concentration, and oxygenation of spirits and spirituous liquors, and in the

apparatus employed therein, and in raising and forcing the same; parts of which are applicable to the manufacture of vinegar, to the raising and forcing of liquids, to the beating, cooling, and oxygenating of beer and liquids, and to the construction of chimneys."—A communication from François Haeck, Brussels, Belgium.—Petitions recorded March 30, 1864.

801. James George Beckton, Whitby, Yorkshire, "Improvements in engines or machinery for forcing, blowing, or exhausting air and other gaseous fluids."

806. Richard Archibald Brooman, Fleet Street, London, "Improvements in gas generating apparatus."—A communication from E. F. A. Goguel, Audincourt, France.—Petitions recorded March 31, 1864.

809. James Hieks, Hatton Garden, London, "An improved maximum mercurial thermometer."

817. John James Lundy, Leith, N.B., and Robert Irvine, Musselburgh, N.B., "Improvements in the manufacture of paper."—Petitions recorded April 1, 1864.

820. Stephen William Silver, Bishopsgate Street Within, London, "The preparation of the milk gum, or juice of the sapota mulieri, or bullet tree."—A communication from John Thornborrow Manifold, Demerara, British Guiana.—Petition recorded April 2, 1864.

834. Leonard Cooke, Horwich, Lancashire, "Improvements in the manufacture of paper."—Petition recorded April 4, 1864.

841. Stephen Martin the younger, Sheffield, Yorkshire, and Edward Young, Oughtibridge, near Sheffield, "Improvements in the manufacture and application of fire-resisting cements and materials."

843. Napoleon Sarony, Broad Street, Birmingham, "Improvements in photography."

848. Richard Archibald Brooman, Fleet Street, London, "Improvements in the manufacture of artificial fuel." A communication from François Celestin, Armelin, Paris, France.—Petitions recorded April 5, 1864.

856. Edward Thomas Hughes, Chancery Lane, London, "An improved controlling apparatus for registering the quantity and quality of alcohol obtained in distilleries." A communication from Trangott Glaeser, Brieg, and Ernst Hofmann, Breslan, Silesia, Prussia.

857. John Ligbtfoot, Aecrington, Lancashire, "Improvements in sizing textile fabrics and yarns."—Petitions recorded April 6, 1864.

877. John Pickering, Spitalfields, London, "Improvements in refrigerators, or apparatus for refrigerating or cooling wort and other liquids."—Petition recorded April 7, 1864.

926. Auguste Audigier, Marseilles, France, "Embalming and mummifying dead bodies."

928. John Campbell Evans and John Calvin Thempson, East Greenwich, Kent, "Improvements in preserving the bottoms of iron and other ships and vessels."

931. James Neilson and James Gillies, Glasgow, N.B., "Improvements in apparatus for fixing or closing capsules on bottles and other vessels."—Petitions recorded April 13, 1864.

Notices to Proceed.

3069. Frederick Piercy, Dartmouth, Devon, "Improvements in the application of heat to water and other fluids, and in apparatus for the same."—Petition recorded December 7, 1863.

3089. Peter Hubert Desvignes, Lewisham, Kent, "Improvements in apparatus for exhibiting dissolving views."—Petition recorded December 8, 1863.

3123. John Corby, Dunoon, Argyle, N. B., "Improvements in centrifugal machines for extracting the syrups from sugar."

3133. Richard Archibald Brooman, Fleet Street, London, "Improvements in machinery for grounding or colouring wall paper and other fabrics."—A communication from Richard McMauree, New York, U.S.—Petitions recorded December 11, 1863.

3136. Thomas Clayton, Manchester, "Improvements in generators for making gas from volatile fluids."

3145. John Platt and William Richardson, Oldham, Lancashire, "Improvements in the preparation of clay for the manufacture of bricks, tiles, and other articles which may be made of such material."

3146. Walker Thomas Whitmore Jones, Holles Street, London, "Improvements in apparatus to be applied to lamps."—Petitions recorded December 12, 1863.

3154. Eugène Rascol, Brydges Street, London, "Improvements in the manufacture of glass."—A communication from M. Tony Petitjean, Geneva, Switzerland.—Petition recorded December 14, 1864.

33. Joshua Kidd, Cannon Row, Westminster, "Improvements in supplying and regulating any required liquid used in the process of generating gas or steam, or for the carburating of gas, for supplying and regulating the water to gas-meters, and oil for lubrication, and in apparatus connected therewith."—Petition recorded January 5, 1864.

746. Samuel Bark and Thomas Attwood, Smethwick, Stafford, and James David Robinson, Birmingham, Warwick, "Certain improvements in slides for gaseliers, as also in the means of regulating or stopping the flow of gas; parts of which improvements are also applicable to chandeliers where oil, camphine, or other inflammable liquids are used for illumination."—Petition recorded March 24, 1864.

817. John James Lundy, Leith, N. B., and Robert Irvine, Musselberg, N.B., "Improvements in the manufacture of paper."—Petition recorded April 1, 1864.

931. James Neilson and James Gillies, Glasgow, N. B., "Improvements in apparatus for fixing or closing capsules on bottles and other vessels."—Petition recorded April 13, 1864.

CORRESPONDENCE.

Continental Science.

M. Martins has given an account of the desert of Sahara, from which the following may be extracted:—He divides it into three parts—1st, the desert of the plateaux, which are large surfaces covered with gypsum, which have resisted the erosive action of water, both modern and deluvian; 2nd, the desert of erosion; 3rd, the desert of sand, which is formed of heaps of sand resembling the waves of the sea suddenly rendered immoveable, terminated by sharp angles, by rounded domes, or by sharp points: these waves of sand are covered by a thin vegetation of shrubs and of grasses, which disappears entirely in those parts where the sand is blown about under the influence of the wind. An oasis he describes as a plantation of date palms. These have been greatly increased in number since the introduction of artesian wells.

The following process, by M. Dumas, for ascertaining the richness of crude crystallised sugar is given:—One litre of alcohol of 85° and 50 grammes of acetic acid of 8° are mixed; as much pure sugar as the liquid will dissolve is then added. A decilitre of this liquid is mixed with 50 grammes of the sugar to be tested, and after filtering the liquid, the areometer is placed in it, when every degree lost by the alcoholometer corresponds to a degree of diminution in the richness of the sugar, unless the sugar is very impure, when the variable nature of the impurities renders this kind of assay a little less certain; but for the sugars ordinarily found in the market satisfactory results are obtained.

In Cosmos there is mentioned a new process of tanning, by which a great saving in time and expense is effected. There is also an account of an improvement, by M. Hempel, in the construction of balances for very accurate weighings. It consists in the employment of a needle, which is fixed on a vertical axis projecting upwards from the beam for the ultimate adjustment of the weight.

At the Academy of Sciences of Vienna, M. Hlasiwetz gave an account of an unfinished investigation which he has undertaken, together with M. Barth, upon the resins. M. Felineck presented specimens of a yellow dust which had fallen from the atmosphere in the environs of Breslau over a space of more than 350 square miles. M. Kuex communicated some interesting details of the existence of the thymus gland, of which the function is still unknown.

MISCELLANEOUS.

Chemistry at the College of Physicians.—It is right to state that the error ascribed to Dr. Farre, in a paragraph with the above heading, which we extracted from a contemporary last week, appears to have been a mistake on the part of the reporter.

Royal Institution. — Monday, May 9, at two o'clock, general monthly meeting. Tuesday, May 10, at three o'clock, Professor Marshall, "On Animal Life." Thursday, May 12, at three o'clock, Mr. Hullah, "On Music (1600—1750)." Friday, May 13, at eight o'clock, Mr. J. Scott Russell, "On the Mechanical History of Gun Cotton." Saturday, May 14, at three o'clock, Professor Frankland, "On the Metallic Elements."

Decay of Stone at the Houses of Parliament.—During the past week some experiments have been undertaken with the view of testing the merits of several suggestions which have been submitted to the Chief Commissioner of Works, or described in evidence taken before the Royal Commission in 1861. For the purposes of this practical trial similar portions of the ornamental stonework on the east, west, and north faces of the building were selected, and placed at the disposal of the following gentlemen, for treatment according to their respective processes. All these stone surfaces exhibited signs of decay in about an equal degree, and underwent a cleaning process at the hands of the several operators as a necessary preliminary to applying their chemical solutions. Five small gablets on the west front of the palace (facing Westminster Abbey) were allotted respectively to Mr. Dudley, representing the Fluo-silicic Company; Messrs. Rust and Co., of Lambeth; Messrs. Bartlett, Brothers, of Camden Town; Mr. J. Spiller, of Woolwich; and Mr. A. H. Church, of Cirencester. In a similar manner portions of several buttresses on the river front and north return of the palace were made the subject of experiment under conditions of almost absolute equality as regards the extent of their disintegration. The nature of the materials which have been applied cannot be stated with certainty, but we gather, chiefly from the minutes of evidence already published, that they are composed as follows:—Messrs. Rust and Co. and Messrs. Bartlett advocate the use of recently mixed preparations containing an alkaline silicate in association with a soluble compound of alumina and potash. Messrs. Rust and Co. consider the employment of a small quantity of lime in addition to be advantageous, but whether this should exist in solution, or merely in suspension, appears yet to remain an open question. Mr. Spiller employs an aqueous solution of biphosphate of lime, which is said to have the power of hardening and closing the structure of all calcareous building-stones. Mr. Church has patented the use of the alkaline earths in combination with aqueous silica, prepared by dialysis, for indurating the surfaces of all kinds of stone. The chemical agent employed by the Fluo-silicic Company cannot be defined with certainty; the use of the acid itself seems, however, more probable than that of any of its ready-formed compounds. In addition to these, we understand that Mr. Young is about to apply paraffin to another portion of stone, and Mr. De Wylde to employ his patent solution of "allotropic alumina" with a neutral alkaline silicate. The weather has been very favourable throughout the whole period occupied in the application of these processes, and the public will watch with interest the indications afforded by these competitive trials.

French Cement.—This cement, composed of lime and india-rubber, is very valuable for mounting large microscopical preparations. The principal advantages are—that it never becomes perfectly hard, and thus permits considerable alteration to take place in the fluid contained in the cell without the entrance of air, and it adheres very intimately to glass, even if it be perfectly smooth and unground. If a glass cover is to be affixed to a large cell containing fluid, a small piece of the cement is taken between the finger and thumb and carefully rolled round until it can be drawn out into a thread about the eighth or tenth of an inch in thickness; this is applied to the top of the cell, before introducing any fluid, and slightly pressed down with the finger previously moistened. It adheres intimately. The preservative fluid with the preparation are now introduced, and the cell filled with fluid, which indeed is allowed to rise up slightly above the walls. The glass cover, rather smaller than the external dimensions of the cell, and slightly roughened at the edges, is to be gently breathed upon, and then one edge is applied to the cement, so that it may be allowed to fall gradually upon the surface of the fluid until it completely covers the cell, and a certain quantity of the superfluous liquid is pressed out. By the aid of any pointed instrument a very little cement is removed from one part, so that more fluid may escape as the cover is pressed down gently into the cement. The pressure must be removed very gradually, or air will enter through the hole. A bubble of air entering in this manner may often be expelled again by pressure, or it may be driven out by forcing in more fluid through a very fine syringe at another part of the cell, but it is far better to prevent the entrance of air in the first instance. The edge of the glass cover being thoroughly embedded in the cement, the small hole is to be carefully plugged up by a small piece of cement, and the cell allowed to stand perfectly still for a short time, when it may be very gently wiped with a soft cloth. The edges of the cement may be smoothed by the application of a warm iron wire, and any superabundance removed with a sharp knife. A little Brunswick black or other liquid cement may be applied to the edges for the purpose of giving the whole a neater appearance. The cement is made as follows:—A certain quantity of india-rubber scraps is carefully melted over a clear fire in a covered iron pot. When the mass is quite fluid, finely powdered lime, having been slacked by exposure to the air, is to be added by small quantities at a time, the mixture being well stirred. When moderately thick, it is removed from the fire and well beaten in a mortar, and moulded in the hands until of the consistence of putty. It may be coloured by the addition of vermilion or other colouring matter. This cement answers well for fixing on the glass tops of large preparation jars, but if moderately strong spirit be used a little air must be permitted to remain in the jar.—*From "How to Work with the Microscope," by Lionel S. Beale.*

ANSWERS TO CORRESPONDENTS.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publishers, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

A Student.—We do not think that oxalate of lime has any commercial value. In answer to the third question, "In what way could a student utilise oxalate of lime himself?" we might suggest that he should burn it, and make his lime water from the residue.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*On the Reciprocal Action of the Oxides of Mercury and Salts with an Earthy or Alkaline-Earthy Base, by M. J. Fonberg.**

The oxides of mercury are generally regarded as weak bases, this opinion being supported by the acid reaction of their salts, not only those corresponding to neutral salts but even those of a basic character, and also by the fact that these salts are easily decomposed by alkalies and alkaline earths. Rose, however, has endeavoured to prove † that the oxides of mercury cannot take an oxacid from an alkaline or alkaline-earthy base, nor a halogen from a corresponding metal. But the assertion of Rose is far from true, since experiment has proved that these oxides have the power of removing halogens from all the alkaline metals without exception; and further, that they act in the same way, though in a less degree, on the oxysalts of the alkalies and alkaline earths.

Before entering upon these experiments it should be mentioned that mercurous oxide, carefully washed and dried in the shade, acts uniformly upon mercuric oxide, and whether in or out of contact with air, the equivalent Hg_2O changes into an equivalent HgO and an equivalent of metal. The latter separates as the action of the protoxide proceeds in such a manner that the final result in the two cases is always the same.

The way to make the experiment upon one or other of the oxides is very simple. It is sufficient to place them in a test tube with a perfectly neutral solution of a salt and shake them together for some moments. With a saturated solution of a haloid salt of an alkaline or alkaline-earthy base the reaction is prompt, and the filtered liquid will show the presence of free alkali, while the presence of mercury is easily seen.

On heating a mixture containing an excess of haloid salt in relation to the quantity of oxide of mercury, the proportion of alkali or alkaline earth, and consequently the proportion of mercuric chloride, iodide, or bromide increases. The free base in the filtered liquid is easily discovered by turmeric paper, &c., and the mercuric compound may be shown by sulphuretted hydrogen, stannous chloride, metallic copper, or even by ammonia.

The mutual action of these chlorides, iodides, and bromides upon the oxides of mercury may be represented by equations, of which the following are examples:—

$$mKCl_2 + HgO = KO + HgCl_2 + (m - 1)KCl_2.$$
$$mKCl_2Hg_2O = KO = HgCl_2 + Hg + (m - 1)KCl_2.$$

Similar equations will represent the action of other haloid salts. For example:—

$$mNaBr_2 + HgO = NaO + HgBr_2 + (m - 1)NaBr_2.$$

It may be objected that all these reactions are only results depending on the simple solution of oxide of mercury in water, but the author has convinced himself that such is not the case, and the following experiments will prove that the solubility of the mercuric oxide does not occasion the phenomena. When an oxide of mercury is boiled for a minute or two with perfectly neutral chloride of barium, the oxide of barium can be easily removed from the filtered solution by means of a current of carbonic acid. If the liquid be examined after the separation of the carbonate of baryta, it is found that the mercuric chloride is in solution joined with the undecomposed chloride of barium. The chlorides of calcium and strontium give analogous results. When operating with chloride of ammonium, boiling must of course be avoided when it is wished to obtain the ammonia in the same liquid in which it is formed. The products of decomposition are precisely similar to those in the preceding cases.

But if chloride of ammonium be boiled with mercuric oxide for half-an-hour in a retort fitted with a well-cooled receiver, the oxide completely disappears, and is entirely changed into corrosive sublimate. In this way we obtain separately a strong solution of ammonia in water in the receiver, and in the retort chloride of ammonium and mercury. Mercurous oxide gives analogous results, with the difference that an equivalent of mercury separates.

When operating in the same way with a haloid salt of an alkaline or alkaline-earthy metal, complete decomposition can only be effected when the salt is in large excess, but it may be effected more promptly by passing simultaneously a current of carbonic acid to remove the oxide formed. This is better applied to the salts of the alkaline-earths, particularly to that of barium. In this case the whole of the oxide of mercury dissolves in the form of chloro-mercurate of barium, while the carbonate of baryta forms a white powder at the bottom. With the chloride of magnesium the carbonic acid is unnecessary, since an oxide of magnesia gradually forms and separates spontaneously.

It only remains to add that these changes are not confined to the haloid, but extend to the oxy-salts, both inorganic and organic; but in these cases the decomposition is very limited. The difference is probably owing to the fact that the oxy-salts of the alkalies do not form double salts with mercuric oxide.

TECHNICAL CHEMISTRY.

On the Preparation and Purification of Benzole, by M. E. Kopp.

I have elsewhere mentioned the superheating process by which we have succeeded, more or less perfectly in converting the heavy tar oils, and which are frequently much charged with napthaline, into lighting gas and volatile oils rich in benzole.

The apparatus for this transformation consists of a horizontal retort of cast iron or earthenware, so arranged that it can be heated to incipient redness by the furnace flame and gases circling round it. One extremity of the retort is formed by a cover, easily adjusted and removed, giving access to the interior, and allowing of the necessary frequent cleaning out of the retort.

At a certain distance from the other well-closed extremity is a partition half the height of the retort, intended to prevent the flow of oil outside the retort.

Beyond this partition the retort communicates with a water chamber by means of a tube placed at the most inclined part of the side.

The lower part of the water chamber communicates by a hydraulic syphon with a waste pipe placed at its extremity, serving to collect the heavy and little volatile oils which condense in this water chamber. But the upper part of the chamber is, moreover, in communication with a good refrigerator of the usual construction, into which pass the more volatile products, which there separate into light oils, which condense, and are collected apart, and into lighting gas, which flows into a gasometer. The operation is conducted in the following manner:—

The retorts (a series of which may be placed in the same

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* Abridged from *Annales de Chimie et de Physique*, March, 1864, p. 300.

† *Poggendorff's Annalen*, vol. vi., p. 298 (1859).

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furnace, and which may communicate with the same water chamber and the same refrigerator) having been heated to clear redness, a continuous thread of heavy oil is poured into them by means of a syphon attached to the exterior part of each retort, and terminating high up, with a funnel to receive the oil from a tap connected with a reservoir above.

As the oil flows into the retorts, it is rapidly affected by the high temperature, which modifies, at least, to a certain extent, its composition and its properties. The result is, more or less, graphitous or light charcoal, which remains in the retort, and more or less volatile oils and gaseous hydrocarbons.

As the volatile and gaseous products penetrate into the water chamber, a first separation is effected, then in this chamber are condensed the heavy and little altered oils, which must afterwards be again passed through the red hot retort; the more volatile products also traverse the refrigerator, where are condensed the light oils produced in the operation, which, rectified in an ordinary alembic, furnish light volatile and colourless oils, rich in benzole.

For the more perfect purification of benzole (or benzine), I propose taking advantage of its property of solidifying under the influence of cold, taking the form of flakes, grouped like fern leaves, or in crystalline masses similar to camphor, melting only at 8°·5 above 0°. For this purpose we cool the rough benzine to —15° in M. Carré's refrigerator, strongly and rapidly press the benzine crystals still impregnated with other liquid hydrocarbides, and thus, with the greatest ease, we obtain crystallised benzine, which, again melted and once more submitted to the same treatment, gives us benzine almost chemically pure.

With such a benzine a pure nitro-benzine may be obtained, very useful in perfumery, and with which perfectly pure aniline may be prepared.

But we doubt whether, in the manufacture of artificial colouring matters, the preparation of chemically pure benzine, nitro-benzine, and aniline, is of so much practical importance as might have been expected; unless, indeed, we can at the same time offer to manufacturers toluol, nitrotoluol, toluidine, and homologous products, so that they can operate on mixtures giving the most advantageous results as much with respect to the beauty and richness of the colour as with respect to the yield.*

After separating the benzine by congelation from light and volatile hydrocarbides, in no case must the mother liquors be mixed with the residues.

On the contrary, they must be treated as if the benzine were still present, and hence perhaps the names toluine, nitrotoluine, and commercial toluidine.

Such a separation and classification will, no doubt, facilitate the preparation and classification of anilines most suitable for various red, violet, and blue tints, and will contribute an important step to the theory of the formation of these colouring matters.—*Moniteur Scientifique*, vi., 329.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following papers will be read:—"Chlorophosphide of Nitrogen. By Dr. Gladstone. "Constitution of Wood Spirit." By Mr. Dancer. "Apparatus for Gas Analysis." By Drs. Williamson and Russell. "Atomic Weights of Metals." By Dr. Williamson.

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* See CHEMICAL NEWS, vol. viii., p. 4.—Dr. Hofmann's "Memoir on the necessity of Mixing Aniline and Toluidine to produce Aniline Red."

PHARMACY, TOXICOLOGY, &c.

On Atropine, by M. PFEIFFER.

Same Subject, by MM. KRAUT *and* LUDWIG.

HAVING, in conjunction with M. Ludwig, ascertained that atropine, when distilled with bichromate of potash and sulphuric acid, induces the formation of benzoic acid, M. Pfeiffer found that by boiling with soda this alkaloid gave rise to a volatile base and an acid, with a very high equivalent.

A similar result was at the same time obtained by M. Kraut, who, moreover, determined the composition and the principal properties of both these products. To the base be gives the name of tropine, the acid he calls atropic acid; but it yet remains unascertained whether these products are identical with those obtained by M. Pfeiffer.

By heating atropine to 100° with baryta water in a closed vessel, M. Kraut found that the alkaloid decomposed, producing a salt of baryta which, in presence of hydrochloric acid, divides into a crystallisable acid and an organic hydrochlorate, which remains in solution; the latter contains the tropine—

$$\underbrace{C_{34}AzH_{23}O_{6}}_{\text{Atropine.}}+2HO=\underbrace{C_{18}H_{8}O_{4}}_{\text{Atropic acid.}}+C_{16}\underbrace{AzH_{17}O_{4}}_{\text{Tropine.}}.$$

Atropic acid crystallises in beautiful needles concentrically grouped, fusible at 105°·5. They form a salt of lime losing over sulphuric acid 13·94 per cent. of water. These properties differ from those of cinnamic acid, with which atropic acid is isomeric.

Atropate of tropine is not crystallisable, is viscous at the ordinary temperature, and liquefies by heat. It does not seem to dilate the pupil.

Hydrochloric acid with heat divides atropine in the same way as does baryta water.

Hydrochlorate of tropine is soluble in water and crystallisable. With oxide of silver it becomes alkaline, and the liquid no longer seems to contain tropine. The same hydrochlorate is precipitated by bichloride of platinum, is soluble by heat, and then crystallises in beautiful orange crystals.

With chloride of gold it forms an equally crystallisable double salt.—*Journal de Pharmacie et de Chimie*, xlv., 282.

PHOTOGRAPHY.

Theoretical and Practical Researches on the Formation of Positive Photographic Proofs, by MM. DAVANNE *and* GIRARD.

PHOTOGRAPHIC images, especially those known as positive proofs, are the result of remarkable transformations, which might, unless properly studied, be considered anomalies. In each new operation the colour, clearness, intensity, and solidity of the result may be very considerably varied, without the cause of the variations being apparent. These hitherto unexplained transformations may, nevertheless, be classed with ordinary chemical reactions. This is what we have endeavoured to prove by a series of researches extending over six years.

To produce a positive proof the photographer takes a sheet of paper, covered with a sizing of albumen, gelatine, or starch, impregnates it with a soluble chloride, and then submits it to the sensitive action of a solution of silver. The image is then ready for insolation; placed under a negative plate it reproduces inversely the most delicate details. At this moment it is very brilliant, but will fade if not fixed by reagents, which dissolve the unacted on salts; and its coloration would be confined to the red tints given by contact with the fixers were it not finally submitted to the action of the colouring liquids called toning agents.

These successive operations require all the attention of the chemist; we have followed them step by step, and each has revealed to us some new facts, of which we will give a succinct *résumé*.

On Paper.—It is a fact well known to photographers that proofs prepared under the same conditions, but on papers of different origin, produce tones varying extremely. The cause of these variations arise from the influence exercised by the sizing of the photographic papers. A proof on unsized paper when taken from the fixing bath is always grey and flat; while on gelatinised, albuminised, or starched paper, it always has red brilliant tone, increasing in vigour with the abundance of the sizing. In this case a combination takes place between the sizing and the silver compounds, and this combination, a true lake colour, manifests its influence towards the finishing of the proof. The fact may easily be directly demonstrated: a mixture of chloride and nitrate of silver long exposed to the light, then heated with hyposulphite of soda, leaves as residue a grey metallic powder; while the same mixture, with the addition of gelatine, albumen, or starch, gives, under the same circumstances, a matter which gradually dries under the form of a brilliant red varnish, and which is found, on analysis, to contain carbon, hydrogen, and nitrogen. This argento-organic lake plays a considerable part in obtaining a photographic image; we shall have fresh occasion to appreciate its importance when investigating the causes of the alteration of the proofs.

The Salting.—The first operation which the paper undergoes is the imbibition of a soluble chloride; for this purpose chloride of sodium is usually employed, but certain authors recommend various other metallic chlorides, attributing special qualities to them. We have shown that the differences in action of these chlorides are more apparent than real; they are always to be ascribed to the varying excess of acid with which the salts are impregnated. With any chloride very various colouring may be obtained; mixed with an excess of acid or alkali, this chloride will always give a redder tinge than if employed in a neutral state; the natural explanation of this result is to be found in the normal action of acids and alkalies on the organic matters employed for sizing.

On Rendering Sensitive.—Chlorinated and dried, the paper is then placed on a bath of nitrate of silver; three things result from this, and the sensitive surface on coming from this bath is formed of chloride of silver, of a combination of gelatine, albumen, or starch, with nitrate of silver, and, lastly, of an excess of free nitrate of silver. The presence of these three substances is indispensable to the production of a good proof; chloride of silver alone gives but a dull and superficial image, but it produces the image rapidly; nitrate in excess gives the necessary depth to this image, and the argentico-organic lake gives it the characteristic red colour. The sensitivising bath may vary in richness, and we have carefully studied the effect of these variations; it may be neutral acid or alkaline; in the two latter cases the effect is the same as if the acid or alkali had been added to the chloride bath.

On Insolation.—To determine the effect of light on the sensitive surface, the composition of which we have given, is certainly, from a theoretical point of view, the most important part of our researches. It is universally admitted that chloride of silver exposed to the solar rays undergoes decomposition and disengages part of its chlorine; but the question is really much more complex than at first appears, and it is necessary to ascertain not only what becomes of the chloride, but also what becomes of the argentico-organic combination of free nitrate.

First as to the chloride. It has long been thought that light reduced this body to the state of sub-chloride Ag_2Cl. We have shown that such is not the case, and we stated that the decomposed chloride separates entirely as chlorine and metallic silver. We have established this, the principal point, by first proving that the product of the action of light on chloride of silver is soluble in hot nitric acid, while the essential property of the sub-chloride Ag_2Cl is its insolubility in this re-agent, and that this product, freed by hyposulphite of soda from the unreduced chloride of silver, contains no trace of chlorine.

It has certainly been objected to this last proof that hyposulphite of soda used as a fixing agent might have decomposed the sub-chloride Ag_2Cl into chloride $AgCl$, which would there dissolve into metallic silver; but the only good experiment cited in support of this hypothesis is the change in the colour of the insolated proof when placed in contact with the fixing agent. Now, we have ascertained that this change of colour is due to quite another cause, to a hydratation of the argentico-organic lake, and that this result is to be obtained by simply exposing the proof to the vapours of boiling water. Chloride of silver, then, is transformed by the action of light into chlorine and metallic silver.

It is the disengagement of chlorine from this decomposition which makes nitrate of silver play so important a part in positive photography. Thus, as we have already observed, a proof obtained with chloride of silver only is always tame and ineffective; in presence of excess of nitrate, on the contrary, it acquires great brilliancy. This result is easily explained; in fact, the action of light on a uniform surface of chloride of silver is soon limited by the opaque layer produced by the superficial reduction of the argentic compound; but if this compound is mixed with free nitrate of silver then, beside the portions reduced, and under the influence of the chlorine, they disengage, there are formed new quantities of chloride, which may then be attacked by light, because before this, in the state of nitrate, these portions occupied a particular place, and the reduced silver did not hitherto recover them; so that instead of a dull image several excessive layers are formed, which give to the design the required depth.

At the same time that the chloride of silver is reduced to a metallic state the argentico-organic combination is also reduced, forming a sort of insoluble lake, which, hydrating by contact with alkaline fixers, communicates a very pronounced red colouring to the proof.

The applications of these fixers is the second phase in the manipulations required in positive photography.—*Comptes-Rendus*, lviii., 634.

Royal Institution.—Tuesday, May 17, at three o'clock, Professor Marshall, "On Animal Life." Thursday, May 19, at three o'clock, J. Hullah, Esq., "On Music (1600—1750)." Friday, May 20, at eight o'clock, James Nasmyth, Esq., "On Day and Night in the Moon." Saturday, May 21, at three o'clock, A. Herschel, Esq., "On Falling Stars."

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, March 18, 1864.

H.R.H. The Prince of Wales, *Vice-Patron, in the Chair.*

A paper by John Tyndall, Esq., F.R.S., Professor of Natural Philosophy, Royal Institution, was read on "*Contributions to Molecular Physics.*"

The speaker had already shown the enormous differences which exist among gaseous bodies, both as regards their power of absorbing and emitting radiant heat. When a gas is condensed to a liquid, or a liquid congealed to a solid, the molecules coalesce, and grapple with each other by forces which were insensible as long as the gaseous state was maintained. But, though the molecules are thus drawn together, the luminiferous ether still surrounds them: hence, if the acts of radiation and absorption depend on the individual molecules, they will assert their power even after the state of aggregation has been changed. If, on the contrary, their mutual entanglement by the force of cohesion be of paramount influence in the interception and emission of radiant heat, then we may expect that liquids will exhibit a deportment towards radiant heat altogether different from that of the vapours from which they are derived.

The first part of the present inquiry is devoted to an exhaustive examination of this question. The speaker employed twelve different liquids, and operated upon five different layers of each, which varied in thickness from 0·02 of an inch to 0·27 of an inch. The liquids were enclosed, not in glass vessels, which would have materially modified the heat, but between plates of transparent rock-salt, which but slightly affected the radiation. His source of heat throughout these comparative experiments consisted of a platinum wire, raised to incandescence by an electric current of unvarying strength. The quantities of radiant heat absorbed and transmitted by each of the liquids at the respective thicknesses were first determined. The vapours of these liquids were subsequently examined, the quantities of vapour employed being proportional to the quantities of liquid traversed by the radiant heat. The result of the comparison was that, for heat of the same quality, the order of absorption of liquids and of their vapours are identical. There was no exception to this law; so that, to determine the position of a vapour as an absorber or radiator, it is only necessary to determine the position of its liquid.

This result proves that the state of aggregation, as far, at all events, as the liquid stage is concerned, is of altogether subordinate moment—a conclusion which will probably prove to be of cardinal importance in molecular physics. On one important and contested point it has a special bearing. If the position of a liquid as an absorber and radiator determine that of its vapour, the position of water fixes that of aqueous vapour. Water had been compared with other liquids in a multitude of experiments, and it was found that, as a radiant and as an absorbent, it transcends them all. Thus, for example, a layer of bisulphide of carbon 0·02 of an inch in thickness absorbs 6 per cent., and allows 94 per cent. of the radiation from the red-hot platinum spiral to pass through it; benzol absorbs 43 and transmits 57 per cent. of the same radiation; alcohol absorbs 67 and transmits 33 per cent., and alcohol stands at the head of all liquids except one in point of power as an absorber. The exception is water. A layer of this substance, of the thickness above given, absorbs 81 per cent, and permits only 19 per cent. of the radiation to pass through it. Had no single experiment ever been made upon the vapour of water, we might infer with certainty from the deportment of the liquid that, weight for weight, this vapour transcends all others in its power of absorbing and emitting radiant heat.

The relation of absorption and radiation to the chemical constitution of the radiant and absorbent substances was next briefly considered. For the first six substances in the list of those examined, the radiant and absorbent powers augment as the number of atoms in the compound molecule augments. Thus, bisulphide of carbon has three atoms, chloroform five, iodide of ethyl eight, benzol twelve, and amylene fifteen atoms in their respective molecules; and the order of their power as radiants and absorbents is that here indicated; bisulphide of carbon being the feeblest, and amylene the strongest of the six. Alcohol, however, excels benzol as an absorber, though it has but nine atoms in its molecule; but, on the other hand, its molecule is rendered more complex by the introduction of a new element. Benzol contains carbon and hydrogen, while alcohol contains carbon, hydrogen, and oxygen. Thus, not only does the idea of multitude come into play in absorption and radiation — that of complexity must also be taken into account. The speaker directed the particular attention of chemists to the molecule of water; the deportment of this substance towards radiant heat being perfectly anomalous, if the chemical formula at present ascribed to it be correct.

Sir William Herschel made the important discovery that, beyond the limits of the red end of the solar spectrum, rays of high heating power exist which are incompetent to excite vision. The speaker has examined the deportment of those rays towards certain bodies which are perfectly opaque to light. Dissolving iodine in the bisulphide of carbon, he obtained a solution which entirely intercepted the light of the most brilliant flames, while to the extra-red rays of the spectrum the same iodine was found to be perfectly diathermic. The transparent bisulphide, which is highly pervious to the heat here employed, exercised the same absorption as the opaque solution. A hollow prism filled with the opaque liquid was placed in the path of the beam from an electric lamp, the light-spectrum was completely intercepted, but the heat-spectrum was received upon a screen and could be there examined. Falling upon a thermo-electric pile, its presence was shown by the prompt deflection of even a coarse galvanometer.

What, then, is the physical meaning of opacity and transparency as regards light and radiant heat? The luminous rays of the spectrum differ from the non-luminous ones simply in period. The sensation of light is excited by waves of ether shorter and more quickly recurrent than those which fall beyond the extreme red. But why should iodine stop the former and allow the latter to pass? The answer to this question no doubt is that the intercepted waves are those whose periods of recurrence coincide with the periods of oscillation possible to the atoms of the dissolved iodine. The elastic forces which separated these atoms are such as to compel them to vibrate in definite periods, and, when these periods synchronise with those of the ethereal waves, the latter are absorbed. Briefly defined, then, transparency in liquids as well as in gases is synonymous with discord, while opacity is synonymous with accord between the periods of the waves of ether and those of the molecules of the body on which they impinge. All ordinary transparent and colourless substances owe their transparency to the discord which exists between the oscillating periods of their molecules and those of the waves of the whole visible spectrum. The general discord of the vibrating periods of the molecules of compound bodies with the light-giving waves of the spectrum may be inferred from the prevalence of the property of transparency in compounds, while their greater harmony with the extra-red periods is to be inferred from their opacity to the extra-red rays. Water illustrates this transparency and opacity in the most striking manner. It is highly transparent to the luminous rays, which demonstrates the incompetency of its molecules to oscillate in the periods which excite vision. It is as highly opaque to the extra-red undulation, which proves the synchronism of its periods with those of the longer waves.

If, then, to the radiation from any source water shows itself to be eminently or perfectly opaque, it is a proof that the molecules whence the radiation emanates must oscillate in what may be called extra-red periods. Let us apply this test to the radiation from a flame of hydrogen. This flame consists mainly of incandescent aqueous vapour, the temperature of which, as calculated by Bunsen, is 3259° C.; so that, if transmission augment with temperature, we may expect the radiation from this flame to be copiously transmitted by the water. While, however, a layer of the bisulphide of carbon 0·07 of an inch in thickness transmits 72 per cent. of the incident radiation, and while every other liquid examined transmits more or less of the heat, a layer of water of the above thickness is entirely opaque to the radiation from the flame. Thus we establish accord between the periods of the molecules of cold water and those of aqueous vapour at a temperature of 3259° C. But the periods of water have already been proved to be extra-red—hence those of the hydrogen flame must be extra-red also. The absorption by dry air of the heat emitted by a platinum spiral raised to incandescence by electricity was found to be insensible, while that by the ordinary undried air was 6 per cent. Substituting for the platinum spiral a hydrogen flame, the absorption by dry air still remained insensible, while that of the undried air rose to 20 per cent. of the entire radiation. The temperature of the hydrogen flame was, as stated, 3259° C.; that of the aqueous vapour of the air was 20° C. Suppose, then, the temperature of aqueous vapour to rise from 20° C. to 3259° C., we must conclude that the augmentation of temperature is applied to an increase of amplitude, and not to the introduction of periods of quicker recurrence into the radiation.

The part played by aqueous vapour in the economy of nature is far more wonderful than hitherto supposed. To nourish the vegetation of the earth the actinic and luminous rays of the sun must penetrate our atmosphere; and to such rays aqueous vapour is eminently transparent. The violet and the extra-violet rays pass through it with freedom. To protect vegetation from destructive chills the terrestrial rays must be checked in their transit towards stellar space; and this is accomplished by the aqueous vapour diffused through the air. This substance is the great moderator of the earth's temperature, bringing its extremes into proximity, and obviating contrasts between day and night which would render life insupportable. But we can advance beyond this general statement, now that we know the radiation from aqueous vapour is intercepted, in a special degree, by water, and, reciprocally, the radiation from water by aqueous vapour; for it follows from this that the very act of nocturnal refrigeration which produces the condensation of aqueous vapour upon the surface of the earth—giving, as it were, a varnish of water to that surface—imparts to terrestrial radiation that particular character which disqualifies it from passing through the earth's atmosphere and losing itself in space.

And here we come a question in molecular physics which at the present moment occupies the attention of able and distinguished men. By allowing the violet and extra-violet rays of the spectrum to fall upon sulphate of quinine and other substances Professor Stokes has changed the periods of those rays. Attempts have been made to produce a similar result at the other end of the spectrum to convert the extra-red periods into periods competent to excite vision—but hitherto without success. Such a change of period, the speaker agreed with Dr. Akin in believing, occurs when a platinum wire is heated to whiteness by a hydrogen flame. In this common experiment there is an actual breaking up of long periods into short ones—a true rendering of universal periods visual. The change of refrangibility here effected differs from that of Professor Stokes—firstly, by its being in the opposite direction—that is, from lower to higher; and secondly, in the circumstance that the platinum is heated by the collision of the molecules of aqueous vapour, and before their heat has assumed the radiant form. But it cannot be doubted that the same effect would be produced by radiant heat of the same periods, provided the motion of the ether could be rendered sufficiently intense. The effect in principle is the same, whether we consider the platinum wire to be struck by a particle of aqueous vapour oscillating at a certain rate or by a particle of ether oscillating at the same rate.

By plunging a platinum wire into a hydrogen flame we cause it to glow, and thus introduce shorter periods into the radiation. These, as already stated, are in discord with water; hence we should infer that the transmission through water will be more copious when the wire is in the flame than when it is absent. Experiment proves this conclusion to be true. Water from being opaque opens a passage to 6 per cent. of the radiation from the flame and spiral. A thin plate of colourless glass, moreover, transmitted 58 per cent. of the radiation from the hydrogen flame; but when the flame and spiral were employed, 78 per cent. of the heat was transmitted. For an alcohol flame Knoblauch and Melloni found glass to be less transparent than for the same flame with a platinum spiral immersed in it; but Melloni afterwards showed that the result was not general, that black glass and black mica were decidedly more diathermic to the radiation from the pure alcohol flame. The reason for this is now obvious. Black mica and black glass owe their blackness to the carbon diffused through them. This carbon, as proved by Melloni, is in some measure transparent to the extra-red rays, and the speaker had succeeded in transmitting between 40 and 50 per cent. of the radiation from a hydrogen flame through a layer of carbon sufficient to intercept the light of the most brilliant flames. The products of combustion of the alcohol flame are carbonic acid and aqueous vapour, the heat of which is almost wholly extra-red. For this radiation, then, the carbon is in a considerable degree transparent, while for the radiation from the platinum spiral, it is in a great measure opaque. By the introduction of the platinum wire, therefore, the transparency of the pure glass and the opacity of its carbon were simultaneously augmented; but the augmentation of opacity exceeded that of transparency, and a difference in favour of opacity remained.

No more striking or instructive illustration of the influence of coincidence could be adduced than that furnished by the radiation from a carbonic oxide flame. Here the product of combustion is carbonic acid; and on the radiation from this flame even the ordinary carbonic acid of the atmosphere exerts a powerful effect. A quantity of the gas, only one-thirtieth of an atmosphere in density, contained in a polished brass tube four feet long, intercepted 50 per cent. of the radiation from the carbonic oxide flame. For the heat emitted by solid sources olefiant gas is an incomparably more powerful absorber than carbonic acid; in fact, for such heat the latter substance, with one exception, is the most feeble absorber to be found among the compound gases. For the radiation from the hydrogen flame, moreover, olefiant gas possesses twice the absorbent power of carbonic acid, but for the radiation from the carbonic oxide flame, at a common tension of one inch of mercury, while carbonic acid absorbs 50 per cent., olefiant gas absorbs only 24. Thus we establish the coincidence of period between carbonic acid at a temperature of 20° C. and carbonic acid at a temperature over 3000° C., the periods of oscillation of both the incandescent and the cold gas belonging to the extra-red portion of the spectrum.

It will be seen from the foregoing remarks and experiments how impossible it is to examine the effect of temperature on the transmission of radiant heat if different sources of heat be employed. Throughout such an examination the same oscillating atoms ought to be retained. The heating of a platinum spiral by an electric current enables us to do this while varying the temperature between the widest possible limits. Their comparative opacity to the extra-red rays shows the general accord of the oscillating periods of our series of vapours with those of the extra-red undulations. Hence, by gradually heating a platinum wire from darkness up to whiteness, we gradually augment the discord between it and the vapours, and must therefore augment the transparency of the latter. Experiment entirely confirms this conclusion. Formic ether, for example, absorbs 45 per cent. of the radiation from a platinum spiral heated to barely visible redness; 32 per cent. of the radiation from the same spiral at a red heat; 26 per cent. of the radiation from a white-hot spiral, and only 21 per cent. when the spiral is brought near its point of fusion. Remarkable cases of inversion as to transparency occurred in these experiments. For barely visible redness formic ether is more opaque than sulphuric; for a bright red heat both are equally transparent, while, for a white heat, and still more for a nearly fusing temperature, sulphuric ether is more opaque than formic. This result gives us a clear view of the relationship of the two substances to the luminiferous ether. As we introduce waves of shorter period the sulphuric augments most rapidly in opacity; that is to say, its accord with the shorter waves is greater than that of the formic. Hence we may infer that the molecules of formic ether oscillate, on the whole, more slowly than those of sulphuric ether.

When the source of heat was a Leslie's cube filled with boiling water and coated with lampblack, the opacity of formic ether in comparison with sulphuric was very decided. With this source also the position of chloroform as regards iodide of methyl was inverted. For a white-hot spiral, the absorption of chloroform vapour being 10 per cent., that of iodide of methyl is 16; with the blackened cube as source the absorption by chloroform is 22 per cent., while that by the iodide of methyl is only 19. This inversion is not the result of temperature merely; for when a platinum wire, heated to the temperature of boiling water, was employed as a source, the iodide remained the most powerful absorber. All the experiments hitherto made by the speaker go to prove that from heated lampblack an emission takes place which synchronises in an especial manner with chloroform. For the cube at 100° C., coated with lampblack, the absorption of chloroform is more than three times that of bisulphide of carbon; for the radiation from the most luminous portion of a gas-flame the absorption by chloroform is also considerably in excess of that by bisulphide of carbon; while, for the flame of a Bunsen's burner, from which the incandescent carbon particles are removed by the free admixture of air, the absorption by bisulphide of carbon is nearly twice that by chloroform. The removal of the incandescent carbon particles more than doubled in this instance the relative transparency of the chloroform. Testing, moreover, the radiation from various parts of the same flame, it was found that for the blue base of the flame the bisulphide was the most opaque. For the radiation from a very small gas-flame, consisting of a blue base and a small white top, the bisulphide was also most opaque, and its opacity very decidedly exceeded that of the chloroform when the flame of bisulphide of carbon was employed as a source. Comparing the radiation from a Leslie's cube coated with isinglass with that from a similar cube coated with lampblack, at the common temperature of 100° C., it was found that, out of eleven vapours, all but one absorbed the radiation from the isinglass most powerfully; the single exception was chloroform. It may be remarked that, whenever, through a change of source, the position of a vapour as an absorber of radiant heat was altered, the position of the liquid from which the vapour was derived was changed in the same manner.

It is still a point of difference between eminent investigators whether radiant heat, up to a temperature of 100° C., is monochromatic or not. Some affirm this; some deny it. A long series of experiments has enabled the speaker to state that probably no two substances at a temperature of 100° C. emit heat of the same quality. The heat emitted by isinglass, for example, is different from that emitted by lampblack, and the heat emitted by cloth or paper differs from both. It is also a subject of discussion whether rock salt is equally diathermic to all kinds of calorific rays, the differences affirmed to exist by one investigator being ascribed by others to differences of incidence from the various sources employed. MM. de la Provostaye and Desains maintain the former view, Melloni and M. Knoblauch maintain the latter. The question was examined by the author without changing anything but the temperature of the source. Its size, distance, and surroundings remained the same, and the experiments proved that rock salt shares, in some degree, the defect of all other substances. It is not perfectly diathermic, and it is more opaque to the radiation from a barely visible spiral than to that from a white-hot one.

In regard to the relation of radiation to conduction. Defining radiation, internal as well as external, as the communication of motion from the vibrating molecules to the ether, the speaker arrives, by theoretic reasoning, at the conclusion that the best radiators ought to prove the worst conductors. A broad consideration of the subject shows at once the general harmony of the conclusion with observed facts. Organic substances are all excellent radiators; they are also extremely bad conductors. The moment we pass from the metals to their compounds we pass from a series of good conductors to bad ones. Water, among liquids, is probably the worst conductor; it is the best radiator. Silver, among solids, is the best conductor; it is the worst radiator. In the excellent researches of MM. de la Provostaye and Desains the author finds a striking illustration of what he regards as a natural law; that those molecules which transfer the greatest amount of motion to the ether, or, in other words, radiate most powerfully, are the least competent to communicate motion to each other, or, in other words, to conduct with facility.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture IX.—*Thursday, January 21, 1864.*

(Continued from page 224.)

I will conclude my remarks with reference to sea-water by presenting you with an analysis of the residue of two specimens. We will first take water near ourselves, and then compare it with the specimens from the western coast of South America. You will see that the two are not very dissimilar, although they are taken from places at a great distance from each other.

Solid Residue.

	Water from England.	Water from the Western Coast of South America.
Chloride of sodium .	. 74·20	75·80
Chloride of magnesium	. 11·04	8·80
Chloride of potassium	. 3·80	3·68
Bromide of potassium	. 1·09	1·23
Sulphate of lime .	. 4·72	4·54
Sulphate of magnesia.	. 5·15	5·88

There is a considerable difference between the chloride of magnesium in the two specimens. The proportion of residue of the water taken from England was 34·4 in the thousand, and the proportion of that of the other specimen was 32·8 in the thousand.

I will next call your attention very briefly to certain saliferous deposits. I might multiply here to a very great extent, but I am afraid to do so.

The first mineral to which I will call your attention is one of great interest. It is a very simple one, namely, thenardite. It is an anhydrous sulphate of soda, and it was found first of all near Madrid; specimens from South America have been brought over by Mr. Bullar. It is exquisitely crystallised, and singularly enough, it contained a little iodine in some form or other. We do not exactly know in what form, but on heating it in closed tubes iodine is evolved. We had it carefully analysed here some time ago. I mention this to show what an important indication with respect to temperature we may derive even from a small quantity of mineral like that. In this tube by the side of the natural mineral I have placed the artificial mineral. It is produced in the same form, and in all respects in the same way. When we can produce this artificial mineral we may naturally infer that similar conditions existed in the formation of the native mineral. There is another mineral termed glauberik, which is a double sulphate of soda and lime. It occurs in South America, and has two forms. It is associated especially with a very important mineral termed haysine (?), which is now a source of boracic acid.

The next important deposit is one which ought to have a lecture devoted exclusively to it, namely, gypsum. It is a compound of sulphuric acid and lime, and two equivalents of water. There is a ready source of gypsum in sea-water. It is a product of the decomposition of carbonate of lime by sulphuric acid. Suppose in some volcanic regions where sulphurous fumes are evolved those fumes come in contact with a rock containing lime and silica, and so on, the rock is attacked, and becomes a sulphate with certain other ingredients—it may be iron and alumina. From these we may obtain without difficulty sulphate of lime—a deposited crystallised sulphate of lime. Suppose we have first of all lime alumina and iron in that rock, we shall get sulphate of lime formed directly. We shall also get sulphate of iron and sulphate of alumina formed directly, and these coming in contact with a certain mineral water let fall immediately sulphate of lime. I may refer you for information on this interesting point to Bunsen's most remarkable paper on the pseudo-volcanic phenomena of Iceland, which is deserving of the most attentive study. He there speaks of the action exercised upon this plagonite rock, which consists essentially of silica, sesquioxide of iron, alumina, lime, magnesia, and so on. The facts which he mentions are very interesting as bearing on geology. Then we find gypsum frequently in connection with common salt, and with dolomite. In the slag there is one part where the connection is so intimate that they pass the one into the other by the most insensible gradations.

I had intended to speak at length on nitrate of soda, but I must defer that for the present.

We will now pass on to the consideration of a subject of the highest possible interest to us all, namely, carbon, which forms so large a part of the solid crust of the earth. It exists everywhere in the atmosphere as carbonic acid, in all limestone rocks in the form of carbonic acid in connection with lime, and in all organic matter—as wood, peat, and coal.

Carbon is known in three distinct chemical states. When speaking of silica I called your attention to three remarkable allotropic or elemental conditions of that substance, namely, an amorphous and two crystalline forms. We have a parallel series in the case of carbon. I spoke to you of the diamond-like silica. Carbon crystallises in the cubical or regular system, forming the well-known and magnificent gem, the diamond. It crystallises in the rhombohedral system, forming the mineral called graphite, which we can produce artificially, and well crystallised too. Then we have it in the amorphous state, with which every one is familiar.

Diamond occurs of various colours, and very beautiful colours they sometimes are. It is often not uniformly coloured throughout, the colour appearing to depend on enclosed foreign matter locally distributed. It has been found by Wöbler that green diamonds strongly heated became brown, whilst brown diamonds remained unchanged. At a very high temperature the diamonds became black, opaque, and coke-like, increasing at the same time in volume. Crystals and particles of gold have been found enclosed in diamonds. These are apparently exceedingly trifling points, but they are of enormous interest when viewed in connexion with the various theories which have been put forth to account for the formation of diamond. In the British Museum is a specimen of diamond containing an octahedral crystal of gold. I believe that in the museum at Rio (?) are diamonds upon which quartz crystals are distinctly impressed. Diamonds sometimes enclose other diamonds. In a diamond of Bahia minute yet distinct crystals similar to those of iron pyrites have been found to be enclosed, but the true nature of these crystals is at present only a supposition. They have not been clearly determined by chemical analysis to be iron pyrites, however probable it may be. It would, indeed, be a most interesting fact to be sure that a diamond did contain this bisulphide of iron enclosed, because facts like these, although they may not tell us exactly how to make the diamond, may tell us how it has not been made, and that is a very important consideration.

Many diamonds have been burned in oxygen gas for the purpose of chemical analysis, especially by Dumas and Stas in their determination of the atomic weight of carbon a good many years ago. I believe it was in 1841. They always found a residue. This residue sometimes formed a sort of spongy net-work of a reddish yellow colour; at other times it was in the form of crystalline straw-yellow particles; and sometimes it was colourless, and consisted of crystalline fragments. The same residues were obtained from large diamonds. The exact French expression is "very large" diamonds—*très gros*; they were well brushed and boiled for a long time with nitro-muriatic acid, which shows that there was no source of error from adhering foreign matter. On analysis the residue has been found to amount to about one-thousandth; it has been examined, and found to contain silica and iron, but the quantity on which we can operate is very small. It is a very expensive matter to get sufficient for the purposes of analysis. It is a very curious point that in these diamonds we should find both silica and iron. It has been maintained that an organic structure exists in this residue, and also in the diamond itself, but this is a point which has been carefully investigated by one of the best authorities in Europe, and the statement was found to have no foundation.

Now, for the occurrence of diamonds in nature, I may refer you to a most excellent paper on this subject—the best I have met with—which is to be found in the *Annales des Mines* for 1860. It is a tranalation by M. Delesse, of the German Geological Society, of a paper by MM. Heusser and G. Claraz on the occurrence of diamonds in Brazil. It is too long to give anything like proper extracts from, but I refer you to it with very great confidence. It abounds with information of the very highest interest.*

The diamond occurs, and is well known, in what is called itacolumite. This itacolumite is a quartsite, or a sort of soluble sandstone, granular and very friable, and often contains talc, chlorite, and mica. It almost always shows a schistose or slatey structure. The paper I have referred to gives all the details connected with this subject, and corrects the mistake with respect to the assertion that hornblende has been found in schist containing diamond. This is never the case. I should very much like to see this paper translated into English. I think it would interest a very large number of English readers. It is impossible to curtail it with anything like justice to it.

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* We shall shortly give an abstract of this important paper.—Ed. C. N.

There is in this paper a very curious point bearing upon a subject of now very great interest—the antiquity of man. The writer says:—"A very curious fact is the discovery in the cascalho—(that is, the stuff in which the diamond occurs)—of small fragments of quartz, having the form of an anvil. They have been polished, and have, no doubt, been made by the Indians, to whom they served as earrings." Then he says:—"The cascalho in which they have been found had not been previously worked in historical times and formed the bed of a river almost entirely dried up. It was found covered with more than six metres of vegetable soil, on which had grown magnificent palm trees." Then he goes on to say that the polished quartz articles were accompanied with other cut objects, such as arrow-points; and there were also bones, upon the nature of which they could not pronounce. He concludes from this that these remains demonstrate very great antiquity with regard to man. I do not know whether this particular passage has attracted the attention of those now occupied with this subject. If not, I should be glad to have an opportunity of bringing it before them.

Numerous theories have been put forth with regard to the formation of the diamond, and many experiments have been made on the subject. I need hardly tell you that in spite of the assertion which has been recorded that M. D. has made diamonds by electricity, there is no evidence to show the smallest trace of the diamond, crystallised in its cubical system, having been formed by man; but we are so sanguine about this matter that we cannot refrain from believing that one day or other the thing must be done. It assuredly will be done. We have apparently been very near it from time to time, but have never yet reached it.

Among the theories of the formation of the diamond, we are told by Liebig, for instance, that it is the final product of the decay of vegetable matter. That is a mere assertion. Diamond represents pure carbon, and so does graphite, so that in this respect the one stands in the same relation to this decay as the other. It is very strange that although this decay has been going on for thousands of years, we have not found diamonds where they would have occurred—in our coal measures. They are the last places where we should look for diamonds—at all events, for white diamonds. Even Dr. Wilson, of Edinburgh, took up this theory of Liebig; but I repeat that there is not the slightest foundation for such a statement concerning the formation of diamond in nature. Some of us have tried experiments extending over many years. We have taken bisulphide of carbon, a liquid possessing a highly refractive power, and perfectly limpid and colourless, and tried in vain to decompose it by the slow operation of a metal like silver acting during ten or twelve years, but there was not the slightest trace of carbon separated. It has seemed probable that the iodine compounds of carbon would furnish a likely means of enabling us to separate this wonderful mineral in a crystalline form, but no successful results have been obtained.

We shall resume this subject in the next lecture.

PHARMACEUTICAL SOCIETY.

May 4.

T. N. R. Morson, *Esq., in the Chair.*

Dr. De Vry communicated a paper "*On the Cinchona Cultivation in British India*," which was read by Mr. Hanbury. After a six years' residence in Java, the author has obtained leave of absence for two years to recruit his health; and on his way home he made a visit to the British cinchona plantations in Ceylon and on the Neilgherry Hills in the Madras Presidency. Two systems of cultivation appear to be followed in the British possessions, one in dense forest shade, and the other in the open sunshine. In the Dutch settlement at Java the plants are grown in dense shade, and the author was anxious to investigate for himself the results of the cultivation in sunshine. In Ceylon he found the Cinchona Succirubra grown at an elevation of 1600 feet in the shade. The plants were healthy, and from 8 to 9 feet high. They were found to grow better in loftier situations, and the leaves in plants grown in high situations contained twice as much quinovic acid as in those grown in lower. An immense number of the Cinchona Succirubra plants are growing in Ceylon, some in sunshine and some in shade; and a plant thirty-one months old has attained a height of 10 feet and the circumference of 7 inches. At one station there were fifty-seven healthy plants of Cinchona Calisaya. The loss of plants by death, Dr. De Vry was surprised to learn, was only $\frac{1}{10}$th per cent. in Ceylon; in Java the average loss was 10 per cent. From Ceylon the author went to India, and visited Otacamund, where he found the plants under Mr. McIvor's charge in an excellent state. In three years the number has increased from 1000 to 248,166; and a most extraordinary instance of multiplication was seen in the case of the single specimen of C. Uritasinga, received eighteen months before from Mr. Howard, from which plant alone 4730 others had been obtained by cuttings and buds. It was noticed that plants from large cuttings were in a less satisfactory state than those from small. The plants were all healthy, and in this part were grown in open sunshine, which Mr. McIvor considers most favourable to their growth. Wherever he could, Dr. De Vry obtained specimens of leaves and the bark of both root and stem, and these he has submitted to analysis. His results are contained in an elaborate table, which was not read to the meeting. The author estimated the quinine, cinchonine, quinidine, and cinchonidine, and noticed another alkaloid, soluble in ether, which does not give the reactions of quinine, and which somewhat complicated the results. He also determined the quinovic acid in the leaves, which he considers an essential constituent of the cinchonas. Besides this acid, the leaves yielded traces of alkaloids, but not quinine. An experiment had been made to test the effects of thickening the bark by wrapping moss around the stem, and it had proved successful. The bark of a young plant so treated yielded 8·4 per cent. of alkaloids. One unexpected result obtained in Dr. De Vry's experiments was that the root bark was found to contain more of the alkaloids than the bark of the stem. In conclusion, the author expressed his belief that the cultivation of cinchona in India had proved a complete success, and that future results would show it as lucrative as it is now interesting in a scientific point of view.

Mr. Morson called attention to the circumstance of quinovic acid appearing in the plant before the quinine. In the poppy it had been noticed that meconic acid appeared long before morphia.

Mr. D. Hanbury, jun., thanked Dr. De Vry for his interesting communication, and remarked on the extraordinary increase in the number of plants, a single plant being increased to 4000 without seed.

Dr. De Vry said that Mr. McIvor preferred to propagate by cuttings, and not by seeds. He also starved the plants to compel them to make root, which would appear to be the most valuable part of the plant, for he had himself found eight times more alkali in the bark of the root than he had found in the bark of the stem. It might perhaps prove more useful to cultivate the plant for the root than the bark. Experiments were now in progress in Java to determine that point. He believed that the bark of the root of South American cinchona had been used in France.

Mr. Hanbury said that the root bark of the C. Calisaya had been imported into England, but although it was very cheap it would not sell.

Mr. Morson inquired whether quinovic acid possessed any medicinal properties?

Dr. De Vry replied that he believed it had; he had made experiments on the subject, and intended shortly to publish his results.

Professor Bentley said that Dr. De Vry's account of our cinchona plantations was very assuring. One fact mentioned, however, was at variance with a statement of Mr. Howard, who had asserted that the root bark of C. Calisaya only contained one-tenth of the alkaloids found bark of the stem. There was, of course, no question about the accuracy of Dr. De Vry's results, and it might be that the difference was owing to different ages of the plants.

Dr. De Vry said that the whole of his results had been confirmed by Delondre, with whom he had worked.

The next paper was "*On the Preparation of Syrup of Chloroform,*" by Mr. Groves. From the general and extensive use which is made of chlorodyne, the author infers that it has been found convenient to have a preparation from which chloroform does not easily separate on the addition of water. Chloroform is soluble only to the extent of two and a-half minims in an ounce of water, and when a spirituous solution is added to water any excess sinks rapidly to the bottom. Some time ago a Frenchman invented a syrup of chloroform and glycerine—a preparation which Mr. Squire soon showed to be absurd. It has also been proposed to mix chloroform and oil, and then emulsate with gum and sugar. Mr. Groves, however, has found that if the specific gravity of chloroform be reduced by the addition of a lighter fluid to the same specific gravity as a syrup, the two fluids will mix and remain together. The way to make such a mixture is as follows:—Into a twelve-ounce bottle put a fluid ounce of chloroform, and three fluid drachms of ether, and then add an ounce of syrup of honey. Shake these well together, and if any separation take place on standing add *guttatim* more ether until no separation takes place; then fill up the bottle with the syrup. A solution containing an eighth part of chloroform can be obtained, but the author considers the above preparation with one-twelfth preferable. Some physicians, however, prefer such a preparation as chlorodyne, which is miscible with water without separation of chloroform, or from which the chloroform separates in minute globules, easily shaken together again, and then remaining a long time in suspension. For such a preparation Mr. Groves gives the following formula:—Take of

Chloroform, four fluid drachms;
Ether, one fluid drachm and a-half;
Oil of peppermint, eight minims;
Extract of Indian hemp, sixteen grains;
Capsicum, two grains;

macerate these ingredients together for two days, then strain and add to the following solution, previously prepared:—

Muriate of morphia, sixteen grains;
Perchloric acid,
Water, of each half a fluid drachm;
Dilute hydrocyanic acid (Scheele's) 96 minims;
Syrup of treacle, one fluid ounce.

Dissolve the morphia in the syrup and perchloric acid with the aid of gentle heat, and when cold add the hydrocyanic acid. Finally, after mixing the above solutions, add syrup of treacle to make four fluid ounces. In this preparation prescribers will have the several ingredients in known proportions, an all important matter in the intelligent use of remedies. It only remains to add that the syrup of treacle may be replaced with syrup of honey, but the common syrup of sugar does not possess sufficient viscosity to answer well.

Professor Redwood then made a communication "*On Sulphuric Acid.*" The British Pharmacopœia, he said, gives directions for distillation of commercial sulphuric acid, and describes the result as monohydrated acid having the density 1·846. On a former occasion the Professor had said that the monohydrated acid could not be obtained in this way, and that if it could it was an objectionable preparation, since such an acid congeals at a low temperature, and remains solid up to 51° F. The exceptions which had been taken to this statement had led him to make some experiments, although it was a subject which he had before worked on largely. More than sulphuric acid was involved in the question; for, in the Pharmacopœia process for the preparation of glacial acetic acid, the strength of the sulphuric acid used will necessarily affect the strength of the resulting acetic acid; and the Professor had also stated that it was impossible to obtain glacial acetic acid by the Pharmacopœia process. That monohydrated sulphuric acid was not obtained by redistilling the ordinary acid had already been shown by Gay-Lussac, Marignac, Bineau, and the Professor had proved it in former experiments. He had, however, on that day made another experiment, following exactly the directions of the Pharmacopœia. He took 48 fluid ounces of a commercial acid, sp. gr. 1·843; to this he added 1 ounce of sulphate of ammonia, distilled over and rejected one-tenth, as ordered, and then proceeded with the distillation of the acid, collecting the product in fractional quantities of from 3 to 5 ounces. He then took the specific gravity of these several fractionnations, and found that in every instance he had an acid really weaker than that he started with, for the specific gravity never reached 1·842. No doubt one cause of the less density was the absence of foreign matters left behind in the distillation, such as sulphate of lead, which was always present in commercial acid, and the presence of which must necessarily augment the density. As regards the constitution of the distillate, it is quite certain that it is not monohydrated acid. This acid can only be obtained by freezing the Nordhausen acid. When procured, this acid is more glacial than acetic acid, remaining solid up to 51°. The specific gravity is 1·842. When heated, this acid partially decomposes, some anhydrous acid is driven off, and the water remains behind, rendering the residual acid weaker. It is seen, therefore, that the process, the name, and the characters of the acid given in the British Pharmacopœia are all inconsistent with each other. The process will not give the compound described, and the description will not apply to the acid designated. The process, in fact, gives one acid, the definition applies to another, and the characters apply to an acid perfectly distinct from both. Professor Redwood then made some remarks on the process for glacial acetic acid. He had stated that this acid also could not be obtained by the Pharmacopœia method, but it had been objected that he never used the sulphuric acid of the Pharmacopœia density. The only way of getting an acid of this density is to dilute Nordhausen acid with English oil of vitriol, and this he had done, and still could not obtain glacial acetic acid. There are two sources of failure: in the first place, the sulphuric acid contains more water than is necessary to form monohydrated acetic acid; and then there is the difficulty of completely drying the acetate of soda without decomposing it. The salt begins to decompose as soon as it fuses, and some carbonaceous matter is formed. When sulphuric acid is added to this, sulphurous acid is formed, and the water liberated goes to the acetic acid. It is true that glacial acid can be obtained from the Pharmacopœia product, but only by the subsequent process of submitting the distillate to a freezing mixture, draining the crystals, and repeating this operation once or twice. In conclusion, the Professor hoped that he had succeeded in establishing the truth of the statements he had at first made,—about which we think there cannot be the smallest doubt.

The Chairman announced that this would be the last meeting of the season.

Another Sewage Commission.—Lord Robert Montague has obtained a Committee of the House of Commons to consider the plans for utilising the sewage of large towns.

ACADEMY OF SCIENCES.—*May 2.*

In a long paper "*On the Disappearance of Combustible Gases Mixed with Oxygen during the Slow Combustion of Phosphorus,*" M. Boussingault details a lot of experiments which prove that carbonic oxide disappears under the above circumstances, and consequently that it is a bad way of estimating oxygen.

MM. Bussy and Buignet contributed a paper "*On Hydrocyanic Acid.*" The authors point out that when this acid is obtained by acting on equivalent proportions of cyanide of mercury and hydrochloric acid in the ordinary way only about two-thirds of the theoretical quantity of hydrocyanic acid can be procured. The obstacle to the disengagement of the acid they supposed to be the affinity of the corrosive sublimate formed; and they therefore employed an equivalent of chloride of ammonium to combine with the chloride of mercury and annul its influence. In this way they obtained 95 per cent. of the theoretical quantity of hydrocyanic acid. The authors proceeded to notice the changes of temperature with mixtures of real hydrocyanic acid and water, finding in no case a smaller decrease than 7·75°; and with one equivalent of acid and three equivalents of water—that is, equal weights of the two bodies—an abasement amounting to 9·75°. The change of volume was also greatest with these proportions; but singularly enough in this instance the abasement of temperature is attended with *decrease* of volume, the contraction in this instance amounting to 6·23 per cent. The authors account for this anomaly by the supposition of a molecular modification of the state of the hydrocyanic acid; but experimentally they can find no difference in the real acid and that with three equivalents of water. They determined that neither the anhydrous nor hydrated acid had any effect on polarised light, and that the indices of refraction gave no indication of change of state.

A note, entitled "*Researches on the Silico-Tungstic Acids,*" by M. Marignac, gives an account of some interesting bodies. Gelatinous silica boiled with an acid tungstate of potash or soda dissolves; the solution becomes alkaline, and now contains an acid in which one equivalent of silicic is combined with twelve equivalents of tungstic acid. The new acid the author designates *silico-tungstic acid.* It is a strong acid, very stable, which forms two hydrates obtainable in magnificent crystals. Acid tungstate of ammonia, under similar circumstances, gives an acid in which the equivalent of silica is united with ten equivalents of tungstic acid, and hence denominated *silico-decitungstic* acid. This acid is more difficult to separate, the hydrate does not crystallise, and on drying it easily parts with some of the silica, and forms a third acid—*tungsto-silicic,* in which the silica and tungstic acid are found in the same proportions as in silicotungstic. It forms a soluble hydrate, and can be procured in crystals. All these acids are quadribasic; they are as soluble in alcohol as in water; and anhydrous ether forms with them a syrupy liquid miscible with water, but not with the excess of ether. The salts of these acids form with water solutions of extraordinary density. A solution of neutral silico-tungstate of soda, for example, having the sp. gr. 3·05, can be obtained, in which glass, quartz, and most stones will float, and yet is very fluid. [This solution, we may suggest, will form an excellent material for prisms.] Silico-tungstic acid crystallises with 29 eq. of water.—$SiO_2,12WO_3,4HO + 29$ aq. Tungsto-silicic acid crystallises with 20 eq. of water:—

$$12WO_3,SiO_2,4HO + 20 \text{ aq.}$$

The paper is full of interest, and we shall give it in detail.

Some of our readers may be interested to know that *the next appearance of Halley's comet* may be expected (according to the calculations of M. Pontecoulant, presented to the Academy at this meeting) on May 24, 1910.

M. Belhomme, we may mention, has ascertained by experiment that *the pollen of flowers* will retain its fecundating power as long as three years.

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(NINETEENTH NOTICE.)

(Continued from page 215.)

We are fast approaching the end of this important and interesting work, and shall now give but a brief notice of one or two remaining sections, leaving to a future occasion the elaborate essay on manures, which is placed nearly at the end, and which may be considered a distinct work.

Continuing the notice of organic manufactured products, we next come to starch. In this section the Reporter is unable to point out any recent discovery of paramount importance; but it is remarked that the manufacture of starch and its derivatives for food and technical purposes is far from having remained stationary during the last ten years. From the notice of the starch manufacture there is nothing to quote, but we extract a short account of an improved process for obtaining glutin from gluten followed by M. Scheurer Rott, of Thann. The gluten is macerated in water very slightly acidulated with hydrochloric acid. The proportions used are 1500 parts of gluten, 1000 parts of water, and one part of acid. Under this treatment the gluten gradually disintegrates and commences to dissolve. After twelve hours, acetic acid is added, to the amount of $\frac{1}{100}$th of the weight of gluten, and on agitating the mixture a homogeneous magma readily soluble in water is at last obtained. This solution is ready to be used in the printing of fabrics, on which, after steaming, the modified gluten becomes insolubly fixed. The reporter mentions that this new application of gluten has been proposed more especially with a view to the fixing of the aniline colours, but it appears that, as yet, it has been found impossible to prepare from gluten a glutin capable of replacing albumen in all its applications.

Horse-chesnut starch is now made in France by M. Callias on a manufacturing scale, and the only difficulty in the way of extending the industry is that of collecting the raw material. The chesnuts are rasped without previous decortication, and washed upon sieves. The liquid is allowed to settle, and the deposit is washed with water to which alum or sulphurous acid has been added. The bitter principle is soluble in water and alkaline solutions, and is thus removed by repeated washings. Horse-chesnuts are said to yield from 15 to 17 per cent. of starch, which is well suited for dressing, but less so for thickening colours.

Although we have given some account of the researches of M. Musculus in a former volume, we may quote a short paragraph relating to them from the Report, since they may be new to some of our readers, and the results are of importance. M. Musculus has found "that starch, when submitted to the action of boiling water acidulated with a few drops of sulphuric or hydrochloric acid, is not first converted into dextrine and then glucose, as has generally been believed. On the contrary, it splits simultaneously into dextrine and glucose, and the further transformation of the dextrine thus [qy. not] formed into glucose is by no means an easy operation. According to M. Musculus, it is almost impossible, by ebullition under the ordinary atmospheric pressure, however long continued, to convert starch entirely into glucose. This effect can only be produced by digestion at high pressure and temperature. This observation is especially important to distillers of alcohol from amylaceous substances, since dextrine is not susceptible of alcoholic fermentation."

A few words must suffice for a notice of Mr. F. O. Ward's process for separating the ingredients of mixed fabrics. We have already described it when commenting on the contents of the Exhibition, and shall here mention only the results. The fabrics (stuffs generally consisting of a cotton or flax warp and a woollen weft) are submitted to the action of steam for some hours at a pressure of from three to five atmospheres. The joint action of heat and moisture is to convert the animal matter into a friable substance, which retains its form, but crumbles to powder when handled. This, therefore, is removed by beating, and the vegetable fibre is then left in threads just as they formed the warp of the material treated. The vegetable fibre, is of course, applicable to paper making, and the altered animal matter constitutes a manure, which is here said to be more valuable than guano. It is called "ulmate of ammonia," described as a dark-coloured powder, which, in the soil, breaks up more readily than unaltered woollen rags, but not so suddenly as guano. An analysis by Dr. Voelcker shows it to contain nitrogen corresponding to 14·48 per cent of ammonia. Mixed with phosphates, it is said to produce a fertilising compost which leaves nothing to be desired. This is, unquestionably, an ingenious and valuable process.

Passing for a time the "Industry of Manures," we come to the last section of the Report, on "Objects of Scientific Interest." In this section the author refers principally to the results of spectrum analysis, introduced by a short account of the successive observations of the spectrum made by Newton, Wollaston, Wheatstone, and others, which led up to its application to analysis and the invention of the spectroscope.

On this part we need not dwell, as our columns for the last two years have teemed with communications on the subject.

Finally, Dr. Hofmann bestows a few words of well-merited praise on the interesting collections of M. Ménier, Dr. Stenhouse, and Mr. Church, and concludes with an eloquent peroration, which we should be glad to quote entire. One extract, however, must suffice, and we quote a paragraph which contains a valuable suggestion, and which shows the author's modest appreciation of his own work :—

"Possibly at some future Exhibition the machinery of Juries appointed for the award of individual honours may be altogether dispensed with, and replaced by the organisation of competent Commissions, charged to report upon the progress of the various arts and manufactures during a given period. The conception of such a unitary report has been floating in the mind of the reporter while collecting the materials for the preceding imperfect sketches. He would have been glad to compress into a single frame a complete picture of the chemico-industrial movement of the last ten years; so that this report might have remained the chemico-industrial history of a period distinguished by a series of brilliant successes affecting all the material interests of society. But the task has been beyond his powers. Unable to stretch over the immense tract which chemistry, like a mighty river, fertilises, he has been carried along the stream, exhausted by the length of its course, bewildered by the rapidity of its current, perplexed by the endless number of its ramifications."

"But incomplete," as the author says "it is," this report stands alone among those produced by the Exhibition. For breadth of view, for completeness of detail, and for loftiness of tone, it is unequalled; and, as it is, it may well stand as a model for all future reporters.

The Royal Society.—The following list of candidates have been recommended by the Council for election into the Society. The election will take place on Thursday, June 2, at 4 o'clock :—Sir Henry Barkly, K.C.B., William Brinton, M.D., T. Spencer Cobbold, M.D., Alexander John Ellis, Esq., John Evans, Esq., William Henry Flower, Esq., Thomas Grubb, Esq., Sir John Charles Dalrymple Hay, Bart., William Jenner, M.D., Sir Charles Locock, Bart., M.D., William Sanders, Esq., Col. William James Smythe, R.A., Lieut.-Col. Alexander Strange, Robert Warington, Esq., Nicholas Wood, Esq.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

870. Elijah Aldis, Arthur Grove, Kentish Town, London "An improved apparatus for burning magnesium wire for illuminating purposes."—Petition recorded April 7, 1864.

925. Frederick Albert Gatty, Accrington, Lancashire, "Improvements in treating garancine and other products of madder."—Petition recorded April 13, 1864.

952. Charles Doughty and William Drake Key, Lincoln, "Improvements in treating a product obtained in refining the oil of cotton seeds."

955. James Cane Coombe, Swinton Street, London, "Improvements in the preparation of fertilising agents for agricultural, horticultural, and other analogous purposes."—Petitions recorded April 15, 1864.

959. William Clark, Chancery Lane, London, "Improvements in the preservation of animal matters."—A communication from Jean Pierre Liès-Bodart, Boulevart St. Martin, Paris.

961. Walter Payton, Bedford Place, Commercial Road, London, "Improvements in apparatus for measuring water and other liquids."

964. John Riley, Hapton, near Accrington, Lancashire, "An improved sizing substance."

965. Alfred Vincent Newton, Chancery Lane, London, "An improved mode of manufacturing cerealine."—A communication from James Brown, Philadelphia, U.S.—Petitions recorded April 16, 1864.

974. George Davies, Serlo Street, London, "An improved respiratory apparatus."—A communication from Albert Galibert, Paris.—Petition recorded April 18, 1864.

981. Hugo Levinstein, New Bridge Street, Blackfriars, "Improvements in the preparation of purple, violet, and blue aniline dyes."

990. Alexander Colvin Fraser, Loughborough, Leicestershire, "Improvements in apparatus used in the manufacture of gas."—Petitions recorded April 20, 1864.

1000. Henri Adrien Bonneville, Rue du Mont Thabor, Paris, France, "Improvements in photographic apparatus."—A communication from Doctor Desiré Charles Emmanuel van Monckhoven, Ghent, Belgium.—Petition recorded April 21, 1864.

1012. George Davies, Serle Street, London, "Improvements in inhaling apparatus."—A communication from Emile Siegle, Stuttgard, Wurtemburg.

1019. James Edward Duyck, Stamford Street, Blackfriars, Surrey, "Improvements in distilling and purifying petroleum oils and other hydrocarbons, and in apparatus employed therein."—Petition recorded April 22, 1864.

1060. Richard Archibald Brooman, Fleet Street, London, "Improvements in producing photographic pictures photogenically indelible."—A communication from Charles Raphael Maréchal, jun., and Cyprien Mario Tessié du Motay, Metz, France.

Notices to Proceed.

3207. George Haseltine, Southampton Buildings, Chancery Lane, London, "An improved oil, more especially designed for mixing paints and colours, and a new mode of manufacturing the same." A communication from Adolph Millochan, New York, U.S.—Petition recorded December 16, 1863.

3259. Nathaniel Lloyd and Edwin Hargraves, Church, near Accrington, Lancashire, "Improvements in treating printed and dyed fabrics."—Petition recorded December 24, 1863.

5. William Clark, Chancery Lane, London, "Improvements in the manufacture of chlorine." A communication from François Marie Aubert de Tregomain, Paris, France.—Petition recorded January 1, 1864.

363. Peter Armande le Comte de Fontainemoreau, South Street, Finsbury, London, "Improvements in photographic apparatus." A communication from Alphonse Liébert and Jean Lefon, Saint Cyr, Paris.—Petition recorded February 11, 1864.

728. François Louis Roux, Abingdon Street, Westminster, "An improved plastic compound for the protection of metallic and non-metallic surfaces from the action of water, air, and other causes of deterioration."—Petition recorded March 23, 1864.

CORRESPONDENCE.

Oxalate of Lime.

To the Editor of the Chemical News.

Sir,—Having seen in your Answers to Correspondents of last week that "A Student" has been asking what use he can make of the oxalate of lime, may I be permitted to remind him that carbonic ~~acid~~ oxide may be readily obtained by simply heating the dry oxalate in a flask fitted with a delivery tube? It is advisable to pass the evolved gas through a wash bottle containing a little solution of caustic alkali to absorb the small quantity of carbonic acid which usually comes over with the oxide. The residue left in the flask may afterwards be heated still more strongly, and then used in the preparation of lime-water, as you have suggested.—I am, &c.

John Newlands, F.C.S.

MISCELLANEOUS.

Poisoning by Digitaline.—A very important trial is now proceeding in Paris, in which a physician is accused of poisoning a lady by means of digitaline. All the French toxicologists of note will be examined in the case, and their evidence is looked for with much interest.

Young v. Fernie.—This great trial is now so far concluded that it only waits the judgment of the Vice-Chancellor. It occupied the Court eighteen entire days, and parts of sixteen others. Having now the whole of the evidence before us, we shall proceed to give a succinct *resumé* of the principal points in dispute.

The next Pharmacopœia.—At a meeting on April 27, the Medical Council appointed a committee to consider and report on the arrangements to be made for producing the next edition of the "British Pharmacopœia," and on the 29th the following report was received and adopted:—"1. That it is desirable to make further arrangements during the present Session of Council for preparing the next edition of the 'British Pharmacopœia.' 2. That a Committee of the Council be appointed to superintend the preparing for the press, and the editing of the work, and to submit the same to the Council for approval, in proof. 3. That the gentlemen already nominated in London, Edinburgh, and Dublin, for the purpose of reporting from time to time on the improvements in pharmacy, be requested to continue their services, and their report be communicated to the Pharmacopœia Committee of the Council. 4. That an editor or editors shall be appointed by the Pharmacopœia Committee, who shall prepare the work, in all its details, under their control."

The New Pharmacy Bill.—The following are the principal provisions of the bill proposed by the Council of the Pharmaceutical Society. The preamble, of course, recites that it is expedient for the safety of the public that such a bill should pass. Clause 1, then, enacts that after January 1, 1864, all chemists and druggists, not members of the Pharmaceutical Society, who compound prescriptions, shall be examined, unless, as after appears, they be already established in business. Clauses 2 and 3 relate to the appointments of examiners and registrar. Clause 4 permits the registration of chemists and druggists actually in business on payment of a fee not exceeding one guinea. Clause 5 allows the registration of assistants engaged as such before January 1, 1865, on payment of five shillings. Clause 6 allows such assistants and associates (before the above date) of the Pharmaceutical Society to become registered when commencing business on payment of one guinea. Clauses 7, 8, 9, 10, and 11 relate to the evidence required before registration, and the duties of the registrar. Clause 12 imposes a penalty for obtaining registration on false pretences, and Clause 13 imposes a penalty for falsely pretending to be registered. Clause 14 directs the fees payable under the Act to be paid to the treasurer of the Pharmaceutical Society. Clause 15 allows registered chemists and druggists *who have passed the minor examination* to vote at the meetings of the Pharmaceutical Society. Clause 16 legalises the application of the funds of the Benevolent Society to the relief of the newly-registered chemists and druggists, and their widows and orphans.

Gold Mining in Wales.—The most noteworthy fact in connection with British mining which has presented itself during the quarter, has been the production of gold from the quartz lodes of the Cambrian Hills. Many years have passed away since we were told that gold was to be found in Merionethshire. Some of the precious metal was exhibited in 1851, but this had been obtained at a cost which far exceeded its value. In 1861, the Vigra and Clogau mine gave 2784 standard ounces of gold to the adventurers, but in 1862 they obtained 5299 ounces. For some time the prospects were dull, and large quantities of quartz were worked containing no visible gold, and an infinitesimally small proportion was separated by amalgamation. However, the prospects brightened towards the close of the year 1863; and during the past quarter the following quantities have been duly reported:—

	Oz.	dwts.		Cwt.	qr.	lb.	
1	103	11	from	7	1	23	of quartz.
2	185	16	,,	8	1	14	,,
3	296	16	,,	10	3	0	,,
	586	3		26	2	9	

This is, perhaps, the most extraordinary yield of gold from the vein on record. We find, however, by the report of the Vigra and Clogau Mining Company, that since the date of their last report 1059 ounces of gold have been received, this being obtained from quartz giving 24 ounces of gold to the ton.—*Chronicles of Mining, &c., in the "Quarterly Journal of Science."*

Artificial Production of Monsters.—A series of experiments have been made by M. Barthélemy on monstrosities, both artificial and natural, among the lepidoptera. He performed his experiments chiefly on the chrysalis, and endeavoured to cause modifications similar to those obtained by covering the eggs of birds with varnish. On covering the chrysalis with oil, it was found that they died before completing the metamorphoses; but on covering either the thoracic or abdominal part with wax, a retardation of development was perceived, but this was much greater with the thoracic parts. The cephalic part of the nervous system was much retarded in development, but the other parts of the ganglionic chain appeared to be developed as usual. He succeeded also in suppressing the development of the generative organs.

ANSWERS TO CORRESPONDENTS.

T. S. M.—Use strong glue.

A Subscriber.—It is impossible to say what the colouring matter is without analysing the substance.

S.—A list was given in a recent number of the Chemical News.

A Reader.—We report all which are accessible.

Kyonol.—1. Not that we know of. 2. It is precipitated from a salt by a caustic alkali.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Chloro- and Bromo-Metallic Ethers of Thallium, *by* M. J. Nickles.

Some years ago I showed that metallic chlorides and bromides capable of forming chloro- and bromo-salts' could, like simple acids, combine with ether to form definite compounds generally containing several equivalents of ether. The subsequent discovery of thallium has given me the opportunity of verifying this fact with the new metal.

We know in fact, that, among others, thallium forms with chlorine, a compound Cl_3Tl,[*] with which M. Wilm obtained double chloride $Cl_3Tl,3(ClNH_4)$. I find that this trichloride or chloro-thallic acid is able to unite with several equivalents of ether.

By passing a current of chlorine into ether standing over thallium, or, better still, over protochloride ClTl, the whole is gradually dissolved, and after a time the balloon contains simply a limpid liquid, free from all solid matter. By using a sufficient quantity of anhydrous ether, two layers will be found in the balloon; the lower one containing the new chloro-metallic ether[†] mixed with chlorated products, derived from substitution. In this state it fumes in the air, evolving hydrochloric acid gas; it then is very little soluble in ether and water, but is rendered soluble in them by the addition of hydrochloric acid. Alcohol dissolves it easily.

It is not volatile, but is destroyed by heat, leaving a residuum of chloride of thallium and carbon, and evolving hydrochloric acid. It is purified by heating in a water-bath in a current of dry carbonic acid. The gas disengaged takes with it large quantities of hydrochloric gas, and with the ether are condensed the substituted products so well studied by M. Malaguti.

The residue constitutes the compound sought for; in this state it is soluble in ether and water, assisted by a certain quantity of fixed hydrochloric acid. It is also very acid and effervesces with alkaline carbonates. An excess of these separates TlO_3 in a brown powder. Sulphurous acid also destroys this ether, producing protochloride ClTl.

Analytical results agree with the formula—

$$Cl_3Tl,2(C_4H_5O)ClH + 2HO.\text{‡}$$

The water evidently has been carried off by ClH, which, it is well known, condenses aqueous vapour so energetically.

In aqueous solutions of alkaline chlorides this state is speedily changed; by evaporation the liquid gives well crystallised double chlorides.

Bromo-thallic ether, $Br_3Tl,3(C_4H_5O)$ usually partakes of the properties of the preceding ether. Thallium dissolves in bromine only after a considerable time; but in presence of ether the solution is quickly effected; the two layers are formed, the compound in question being in the lower one, which it renders fuming. It is not volatile; heated it gives a residue of bromides of thallium crystallised in yellow needles.

This ether is rapidly produced by mixing bromide of thallium, bromine, and ether. It dissolves in alkaline bromides, forming with them bromo-salts, such as—

$$Br_3Tl,BrNH_4 + 4HO,$$

crystallised in rhomboidal tablets;

$$Br_3Tl,BrNH_4 + 8HO,$$

crystallised in needles.

These two salts melt in their water of crystallisation below 100°; the fixed alkalines precipitate from it TlO_3; sulphurous acid separates thallium from it in the state of protochloride.[§]

Iodo-thallic ether, if it exists at all, is very unstable. By treating thallium by iodine and ether, a brown solution is obtained, which gradually abandons needles of I_3Tl, very soluble in ether, and containing iodine in excess. The same iodide is formed by digesting thallium, iodine, and an alkaline iodide with alcohol. A double iodide is then produced.

Iodo-thallate of ammonium occurs in the form of red rhomboidal tablets, seemingly isomorphous with the foregoing; heat does not melt them, but turns them black and then yellow, driving off not only their water, but also sufficient iodine to reduce I_3Tl to ITl.

I shall return to these combinations as well as to others which may be effected with fluorine,[‖] but for the present must confine myself to verifying with trichloride and tribromide of thallium the fact previously stated—namely, that metallic chlorides and bromides capable of acting as acids will unite with several equivalents of ether, like a polybasic acid.—*Comptes Rendus*, lviii. 537.

The Action of Oxide of Copper on an Alkaline Solution of Glucose, *by* M. E. Reichardt.

By adding to recently-precipitated oxide of copper an excess of potash or soda, and sufficient glucose to produce a limpid blue solution, reduction will be effected at the ordinary temperature; light and heat will accelerate the reaction. If the excess of alkali is inconsiderable, it will be quickly neutralised; the reduction is at this moment arrested. By the following operation the acid formed may be isolated:—

Dissolve a certain quantity of acetate of copper, supersaturate this salt by a slight excess of alkali, keeping the temperature at about 60°; add glucose until the oxide of copper is completely reduced. From time to time ascertain that the liquid remains alkaline; at the end of the operation filter. Neutralise the liquid by acetic acid, slightly exceeding saturation, then precipitate the new acid, gummic acid,[*] by acetate of lead or chloride of barium.

In this liquid thus precipitated, subacetate of lead again precipitates a gum.

Gummic acid is isolated by decomposing its salt of lead by sulphuretted hydrogen, or its salt of baryta by sulphuric acid. When sulphuretted hydrogen is used the acid seems more liable to alteration, and becomes brown by evaporation at 60°. It is better then to precipitate it in the state of salt of baryta, and to decompose this salt by a slight excess of sulphuric acid. The acid solution, evaporated with gentle heat, leaves the acid in the form of rhomboidal prisms, with the strongly acid flavour of citric or tartaric acid.

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[*] Probably meant for $TlCl_3$.

[†] The combination is not effected directly, even at 100°, in a tube containing Cl_3Tl_2 with anhydrous ether.

[‡] We may take this opportunity of stating that the *Comptes Rendus*, the official record of the proceedings of the Academy of Sciences, has for some time past been remarkable for the numerous blunders and misprints which occur in papers on chemical subjects. Many of these we are able to correct in the translation, but we are unable to assist our readers to the comprehension of 2IHO.—Ed. *C. N.*

[§] Protobromide we suppose is meant.

[‖] Such as FlHFlTl+2HO, by treating thallium with hydrofluoric acid, and FlTl by submitting this salt to the action of heat.

[*] This name has already been applied by M. Frémy to the soluble acid obtained by heating metagummic acid with a little potash

The crystallised acid loses no water at 100°. It browns at 130°, melts and decomposes at 150°.

Analyses agree with the formula $C_6H_5O_{10}$, verified by the study of several salts.

Gummic acid is very soluble in water and alcohol. Perchloride of iron neither precipitates nor colours its solutions.

Chloride of calcium with the neutral salts yields a white flaky precipitate of gummate of lime, slightly soluble in an excess of acetic acid, soluble in an excess of chloride of calcium. The author gives it the formula—

$$2CaO,C_6H_5O_{10} + 2HO + Aq.\dagger$$

The *baryta salt* resembles the lime salt. Heat easily decomposes it; even at 100° it disengages water with a feeble acid reaction, leaving carbonate of baryta as residue. It contains—

$$2BaO,C_6H_5O_{10} + HO.$$

Salts of lead and silver contain, one—

$$3PbO,C_6H_5O_{10} + 3HO;$$

the other—

$$2AgO,C_6H_5O_{10}.$$

The latter ignites when heated to 135° or 150°.

Gum.—After the separation of the gummic acid by acetate of lead, a gummy substance, much resembling dextrine, is precipitated. This substance gives, with Trommer's reagent, a green precipitate, which remains unaltered by boiling. Sulphuric acid transforms it into a sugar, reducing the cupro-potassic liquid. Nitric acid oxidises it when hot, with production of oxalic acid.

The analysis of the sodic and barytic combinations of this gum give the formula—$C_{12}H_{15}O_{15}$.—*Bulletin de la Société Chimique*, iii., 197.

Decomposition of Water by Phosphorus, Arsenic, and Antimony, under the Influence of Nitric Acid, with Production of Ammonia, by M. PERSONNE.

THE solution of phosphorus in nitric acid, concentrated or diluted with one or two volumes of water, is, as is well known, effected with disengagement of nitrous vapour, abundant if the acid is concentrated, and diminishing in proportion as it is more diluted. In any case if, when the solution is effected, excess of potash is added to the hot solution, sufficient ammonia is disengaged to become evident, both by reagents and by its odour. Whether normal or amorphous phosphorus is used in this operation, the phenomena and the products are identical.

It was interesting to ascertain whether the fact of the production of ammonia was observable with the bodies forming part of the phosphorus group, as arsenic and antimony.

I operated with distilled arsenic and with antimony purified three times by fusion with nitre.

These two bodies pulverised and heated were attacked by nitric acid, diluted with its volume of water. Under these circumstances arsenic is easily attacked, giving arsenious acid and a little arsenic acid; antimony, on the contrary, is attacked with more difficulty. However that may be, if ammonia is looked for in the liquids obtained it will be found that these two bodies have behaved like phosphorus, with this difference, that phosphorus gives more ammonia than does arsenic, and arsenic more than antimony.

The phenomenon of the formation of ammonia by the decomposition of water under the influence of nitric acid has hitherto been observed only with metals of the third and fourth section, as iron, zinc, tin, &c.

The above observations show that this phenomenon is not limited to these metals, but belongs equally to the metalloids of the phosphorus group.—*Bulletin de la Société Chemique*, vi. 163.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, *F.C.S.*

(*Continued from page 52.*)

6. **Thomas Hobbes.**—On the discovery of the Torricellian vacuum, philosophers became divided into two sects, called respectively "Vacuists" and "Plenists," the former maintaining that a vacuum was possible and capable of being obtained by certain physical processes, the latter that the world was everywhere full, and the production of a vacuum impossible. Among the Vacuists were Otto von Guericke, Pascal, Boyle, and the greater number of the experimental philosophers who were in the habit of meeting at Gresham College for the discussion of scientific matters; and among the Plenists were Mersennus, Noel, Thomas Hobbes, Franciscus Linus, and the Cartesians:—of these latter Boyle writes, "the subtilest and wariest champions for a plenum I have yet met with."

We have previously * spoken of Noel and Mersennus, and we have now to consider the opinions of Thomas Hobbes.†

Of the theological and mathematical writings of Hobbes I can have nothing to say here, but I consider that the views put forward in his philosophical treatises, in so far as they relate to the air, are far less advanced than those of his contemporaries—less advanced, indeed, than those of many of the ancient philosophers who preceded him by nearly twenty centuries. Although intimately acquainted with Bacon and Galileo, the fathers of experimental philosophy, he was himself no experimental philosopher, but he preferred to prove his assertions by reasoning, rather than by well-founded observation and experiment. He deprecated the trying of experiments, and was specially bitter against the recently-formed Society of Experimental Philosophers, the object of which was to do away with the baseless structure of the old speculative philosophy and to found a new philosophy resting on a solid experimental basis.

The language which Hobbes employs in controversy abounds with vituperation, and is in every way utterly unbecoming a philosopher. His arguments are frequently puerile and without weight, and the objections which he urges in order to prove the fallacy of a theory or experiment are often paltry and trifling. In the following words ‡ he addresses Dr. Ward and Dr. Wallis, who had opposed some of his views:—"But I here dismiss you both together. So go your ways, you uncivil Ecclesiastics, inhumane Divines, Dedoctors of morality, unasinous Colleagues, egregious pair of Issachars, most wretched Vindices § and Indices Academiarum, and remember Vespasian's law,‖ that it is uncivil to give ill language first, but civil and lawful to return it."

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† We can hardly understand how this formula can agree with that given for the acid $C_6H_5O_{10}$. The latter is, however, itself improbable on account of the imperfect number of hydrogen atoms it contains.—C. F.

* See the third of these papers, CHEM. NEWS, vol. viii., p. 246.

† Born 1588. Died 1679.

‡ See "Lessons on the Principles of Geometry, to the Egregious Professors of the Mathematics, one of Geometry the other of Astronomy, in the Chairs set up by the noble and learned Sir Henry Savile in the University of Oxford." Lesson vi., "On Manners."

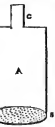
Hobbes himself did not always remember the first sentence of the law, but assuredly be never forgot the last; it is right to add, however, that the learned Savilian professors were by no means so tolerant in the controversy as they might have been, and although they did not make use of such contumelious epithets as Hobbes employs, they occasionally made rather offensive puns on his name:—it is curious, in a treatise devoted to the explanation of some problem in the higher mathematics, to find such words as "*hob*-goblin."

Hobbes did not turn his attention to natural philosophy till somewhat late in life; his adoption of the views of the Plenists may probably be accounted for by the fact that he was well acquainted with Mersennus and Des Cartes, two of the most notorious of the Plenists. In some of his physical views be was almost a Cartesian.

Hobbes did not admit the condensation or rarefaction of matter; he believed the whole world to be full, and that it could not be fuller than full or less full than full.

He conceived that the air consists of an ethereal substance extending as far as the sun, in which ether, myriads of hard atoms possessing simple circular motion of their own, move; these atoms exist in greater quantity near the surface of the earth than at some distance above it. He denied that the air possesses either weight or elasticity. "Utraque illa phantasia," he writes, "tum gravitatis atmosphæræ, tum vis elasticæ sive antitupiæ ¶ aëris, somnium erat."

Hobbes adduces a very simple experiment to prove the universality of a Plenum, an experiment for the production of which there was required neither expensive apparatus nor careful manipulation, for the sole apparatus was a gardener's watering pot, and the experiment was made whenever it was used. The watering pot, which was in use 200 years ago, consisted of a circular vessel A, the bottom of which, B, was pierced with a number of minute holes; it was terminated above by an opening, C, capable of being closed by the finger. Water would obviously be retained in such a vessel by the pressure of the air as long as C remained closed, but directly it was opened water would flow from the bottom of the vessel. That no water flows from A until C is opened is according to Hobbes positive proof of a plenum, for, be reasons, as the world is full, there is no place for the water to go into until C is unstopped, when the air, which is displaced by the descending water, enters and takes the place of the water which flows from the vessel. "And this," he writes, "I take for a sign that all space is full; for without this the natural motion of the water, which is a heavy body downwards, would not be hindered."**



As Hobbes was a plenist, he of course contended that Boyle's air-pump did not produce a vacuum. He speaks of it as being "of the nature of a pop-gun which children use, but great, costly, and more ingenious," and he maintains that the effects produced by it are such as would be produced by a strong wind cooped up in a narrow room. In the first place, when the piston is drawn from one end of the cylinder to the other, be affirms that no air is removed, but sufficient "pure air" to fill the space deserted by the piston enters between it and the surface of the cylinder; for, although the piston was closely fitted into the cylinder with well-oiled leather, it may, he says, keep out "straws and feathers," but not air, "for the body of leather will give passage both to air and water, as you will confess when you ride in rainy and windy weather." (It was by trifling arguments of this sort that Hobbes sought to confute results obtained by one of the most careful and persevering experimenters of the day.) The pure air which forcibly enters between the piston and the surface of the cylinder generates a most violent motion of the air within the air-pump receiver, and this violently-agitated air produces all the effects observed in the receiver after long-continued pumping.

Animals suffer death in the receiver because the rapid motion of the air stops the passage of their blood, but here Hobbes' argument is greatly at fault, for he states elsewhere that the air supports life, because when we breathe we draw in a great number of the swiftly-moving atoms in the air, which pass into the blood, and by their motion cause it to circulate through the veins and arteries; if this be the case, and the above theory obtains, animals ought obviously to have a quicker circulation of blood in the receiver; thus one theory destroys the other, and one is nullified before it leaves the hands of its propounder.

Boyle†† has very ably answered all the objections which Hobbes raises against his "Physico-Mechanical Experiments," and the instruments which he employed for their production, and although first attacked, and somewhat violently too, he carries on the controversy in a far more tolerant spirit than that exhibited by his adversary.

As in the air-pump Hobbes admitted no rarefaction of the air, so in the air-gun‡‡ he admitted no condensation. By working the piston, he contends, large numbers of the hard atoms in the air are forced into the gun, while the pure air escapes between the surfaces of the piston and the syringe; the motion of the injected hard particles becomes greater and greater with every stroke of the piston, and finally when the valve is opened the particles rush out violently, and carry with them a bullet or anything else in their path.

Hobbes, in common with the Plenists, did not allow that the space above the mercury in the Torricellian experiment is a vacuum; his explanation of the suspension of the mercury in the tube is very difficult to understand; he seems to have thought that the weight of the mercury column presses a certain amount of air into the upper part of the tube, and that the column comes to rest when the weight of the mercury is "equal to the force which is required in air to go through it."

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§ Ward had written a work entitled "Vindiciæ Academiarum."

‖ Hobbes alludes to the following saying attributed to Vespasian, "Maledici senatoribus non oportere; remaledicere fas et civile esse."

¶ From ἀντιτυπέω, to repel a blow, to react; a scarcely appropriate term to apply to an elastic body; inasmuch as elasticity signifies that property possessed by the atoms of certain bodies, in virtue of which when their relative position is altered by the addition of force, or the removal of force previously acting, they return to the position which they occupied prior to the addition or subtraction of that force.

** See "The English Works of Thomas Hobbes, of Malmesbury, now first collected and edited by Sir William Molesworth." Eleven vols. 1839-1845.

†† See "An Examen of Mr. T. Hobbes, his Dialogus Physicus de Naturâ Aëris. As far as it concerns Mr. R. Boyle's book of new experiments touching the spring of the Air, &c. By the Author of those Experiments." London. 1662. Also, "Animadversions upon Mr. Hobbes' Problemata de Vacuo" By the Hon. Robert Boyle, Fellow of the Royal Society. London. 1674.

‡‡ The air-gun was invented by M. Marin Bourgeois in 1607. The first account of it is given in a work entitled "Les Elemens de l'Artillerie: concernans tant la theorie que la pratique du Canon. Augmentés en cette nouvelle edition et enrichis de l'invention, description, et demonstration d'une nouvelle artillerie que ne se charge que d'air ou d'eau pure, et a neanmoins une incroiable force, &c. Le tout par le sieur de Flurance Rivaut. Paris, 1608." There is a good copy of this curious work in the British Museum Library.

It had long been known that nitre when thrown on red hot coals engenders very rapid combustion; Hobbes explains this by supposing that nitre consists of "many orbs of salt filled with air," which air rushing violently from the nitre meets particles issuing from the burning coal in an opposite direction, and the two contrary motions produce the intense inflammation observed.

Hobbes was well aware that in many coal mines there exists a kind of matter which suffocates living creatures, and extinguishes flame; he speaks of it as "a certain matter of a middle nature between water and air," and as being perfectly transparent and not much lighter than water; elsewhere he speaks of the deadly fumes given off by burning charcoal, as consisting of a "flameless glowing fire, which dissipates those atoms that maintain the circulation of the blood." I do not find, however, that he traces any connexion between the suffocating gas of coal mines and the suffocating gas of burning charcoal.

Hobbes believed winds to be produced by clouds which descend by their own weight, and strike down the air beneath them; when the dejected masses of air reach the earth they rebound, and thus lateral winds moving in all directions are generated. Thunder and lightning are caused by air enclosed in hollow frozen clouds, which air being more and more pressed, at length the ethereal part of it passes out of the cloud, but a great number of hard particles endued with violent motion remain, and ultimately exert such force that the ice is suddenly broken, and the noise produced by the disruption is thunder.

The learned Editor of Hobbes' works speaks of him as "one of the greatest and most original thinkers in the English language." We speak here solely of his merits as a physical philosopher, and I think it will be admitted that he was neither a great physicist nor a man calculated to forward the interests of the then young experimental philosophy. But was it to be expected that the old speculative philosophy would be overthrown at the first onset? was it to be expected that its disciples would see their fabric destroyed without one blow in its defence? a radical change is never made without opposition, never established without a struggle, and the more violent that struggle the more surely and completely will the change be effected. Hobbes was a follower of the old philosophy, now about to be expelled from the human mind: he lived at the period of the change: should he not rise in the defence of that for which he had devoted his best energies? should he not make an effort to stem that tide which was so rapidly gaining ground?

Men like Hobbes (and we find many such in the history of Science), who rather than allow the falsity of an old and favourite theory, frame a more false theory to support it, even such men indirectly benefit Experimental Philosophy, for by propounding a fallacious theory, they cause experiments to be made for its refutation; and no experiment is made in vain, each one is another stone added to the great and rapidly-increasing structure of our Philosophy.

(To be continued.)

Process for Estimating the Value of Milk.—Take a known weight of the milk, heat it to boiling, then put it in a bottle, and allow it to cool to 12° or 15° (R.). Then shake the bottle until the butter separates, which can be removed, drained, and weighed. This simple operation twice repeated will give satisfactory results.—*Hozerman, Archiv. der Pharm.*, November, 1863

TECHNICAL CHEMISTRY.

Dulos' Processes of Engraving.

A copper plate, on which the design has been traced with lithographic ink, receives, by the action of the pile, a deposit of iron on the parts untouched by the ink; the ink having been removed by means of benzine, the white portions of the design are represented by the layer of iron, and the black by the copper itself; the plate is then plunged into a bath of cyanide of silver, under a galvanic current, and the silver is deposited on the copper only. In this condition mercury is poured over the plate, which attaches itself to the silvered portions only, appearing in relief, and taking the place of the lithographic ink. Then take, in plaster or melted wax, an imprint, the cast of which presenting the counterpart of the projections of mercury, gives a kind of copper plate engraving. This cast has not sufficient strength to bear the press; but by metallising the mould, and depositing upon it, electro-chemically, a layer of copper, we obtain an exact reproduction of the original projections of mercury, and in some sort a matrix by means of which impressions of the plate may be produced *ad infinitum*.

For typographic engraving (figures in relief), the plate of copper should receive, on leaving the hands of the designer, a layer of silver, deposited only on the parts untouched by the lithographic ink; the ink is removed by benzine, the surfaces first covered by the design are oxidised, and the treatment above described is continued. At the end of the operation the raised portions of the electro-chemical plate intended for the impression will be found to correspond with the tracing of the design, and the hollow portions with the thickenings raised about the design by the mercury.

This process, which is the starting-point and the basis of M. Dulos' invention, has led him to the discovery of some more simple methods, which have led to important practical results, the fusible metal or amalgam of copper substituted for mercury giving rapid and remarkably perfect results.—*Moniteur Scientifique*, vi. 215.

PHYSICAL SCIENCE.

Electro-Magnetic Induction Machines for Telegraphy.

A new induction machine is now to be seen in operation which produces a constant stream of electricity, and can be made to produce it of any tension or quantity that may be required. These are valuable properties, which doubtless will be appreciated by all those who are obliged to use galvanic batteries of high tension. Many attempts have been made to use induced electricity for telegraphy, but as these attempts have been generally made with machines similar to Rhumkorf's induction coil, they have failed, for the following reasons:—The electricity is in impulses, and alternately in reverse directions. It is in too small quantity, and too great tension; so much so, that it is said that Mr. Whitehouse's five-feet coil destroyed the Atlantic cable; but the authorities are not agreed on the point. However, it is certain that such machines are not suitable for telegraphy generally, even if one impulse be thrown out, so that all the impulses which are taken may in the same direction; for there is then no approach to a battery current. This has been done, but in all cases the most suitable impulse has been rejected, namely, the slow one, or making impulse, and the breaking impulse taken, which is of greater tension but shorter duration; of course, the absolute quantity of force in each is the same, and it will be clear that the former, approaching more nearly to a current, would be most suitable. In some cases the two reverse impulses are used; but these can only be used with one telegraphing arrangement, and that a slow one.

What has been wanted, and which is now obtained, is as near an approach to a battery current as may be, and of any tension required, without multiplying the number of battery cells used. Any machine to be of real use must not only possess these properties, but must be perfectly self-acting. The machine here spoken of possesses all these properties. Its current is perfectly continuous for all practical purposes, for no intermittance can be detected. It holds the needle perfectly steady, rings an electro-magnetic bell, produces electrolysis, and comports itself in every other way like a battery current, even producing no spark unless the poles be brought into absolute contact. The electricity which is used to excite the electro-magnets in the coils is at the same time made use of as magnetism in the electro-magnets to drive the battery break and commutator; so that the motive power, which makes this machine self-acting, is obtained without cost, because to produce induction the magnets in the coils must necessarily be excited, whether the magnetism so induced be otherwise used or not.

Two series of induction coils are used in this machine, which are so arranged that one series is being magnetised nearly at the same time that the magnetism is subsiding in the other, so that the two consequent induced impulses as it were overlap each other; and though these induced impulses are in opposite directions, the spools are so arranged that in the general induction circuit they flow in the same direction, thus making a compound impulse of longer duration composed of the two opposite inductions, and so blending the more intense with the less, the result being a sort of undulation of force. These compound impulses flow in opposite directions, and to make them a continuous flow they are taken up by a commutator which reverses its contacts as they reverse, and thus turns them all in one direction, producing a slightly-undulating but continuous flow. This seems to be the form of motion that all known forces take. The machine appears to be made for quantity, the inner coils being of No. 12 wire, and the outer of No. 18. Some electricians who have examined it, have expressed a fear that it might injure the insulation of gutta-perchaed wire, as this fault has been attributed to ordinary induction coils. Of course, this objection does not apply to this machine any more than to an ordinary battery; for to whatever purpose it may be applied its tension and quantity will be adjusted to the tension and quantity of the number of battery cells ordinarily required to perform that work; nevertheless, the machine is being subjected to continuous tests to put the thing beyond doubt. A gutta-perchaed wire is punctured and then immersed in water, and the leakage tested, then the full current sent through it for hours, but as yet no perceptible variation has been noticed.

Will it Answer?—Dr. Grusselbake, Professor of Chemistry at the University of Upsala, is said to have restored to activity a snake which had been frozen torpid for ten years. He is also said to have proposed to the Swedish Government to make an experiment on a criminal condemned to death. He proposes to reduce the individual to complete torpor by the gradual application of cold, and to restore him to consciousness after having lain in that condition for a year or two, by sprinkling him with some stimulating wash the professor has invented.

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture X.—*Saturday, January 23, 1864.*

Ladies and Gentlemen,—We will begin by considering more at length the localities in which diamond has been found. In India it is always found in the same kind of matrix—a breccia of red and yellow jasper, quartz, chalcedony, and hornstone, cemented by siliceous matter. This breccia is overlaid by a compact sandstone, and passes into a conglomerate of rounded pebbles or pudding-stone, the particles of which are united by a calcareo-argillaceous cement. The pebbles are easily disaggregated. In this conglomerate diamonds are generally met with. They are found near Cuddapah, on the Pennar river, in a stratum of about two or two feet and a-half in thickness. In this case also its matrix is a conglomerate, in which the pebbles are sometimes very large—as large as the head, and contain hornstone identical with that occurring in the neighbouring mountains. Diamond is found in exactly the same kind of matrix at Banganapilly, Madras, between the rivers Pennar and Krishna. The Gelconda Mines were celebrated in former times, but are now almost, if not quite, deserted. It is reported by Tavernia that in 1669 60,000 persons were employed in the diamond mines there. The bed in which the diamonds are found rests on, and is surrounded by, granite. At Sambulpore, north of the Godavery River, is a bed in which they occur, consisting of the *débris* of the adjacent mountains washed down and deposited by river action. This bed is of ferruginous clay, containing siliceous pebbles, which appear to be derived from the rock originally enclosing the diamonds. It is found also at Bundelcund on a bed of granite overlaid with sandstone, on which is the same kind of breccia, and in this the diamonds are found. The granite here is partially covered with trap, and there no diamonds are met with. More southward the conglomerate is covered by limestone, which is believed by Franklin to be liassic. The sandstone is considered by him to be new red, but I am not quite sure whether that has been established. The sandstone is stated much to resemble the itacolumite of Brazil.

Diamonds are found in Borneo in a conglomerate of pebbles, diorite, and quartz, along with marl containing marine shells. Diamonds are there associated with magnetite—that is, magnetic oxide of iron—gold, platinum, and other things. They are also associated with a black quartz enclosing iron pyrites and occasionally also particles of platinum. This black stone is considered to be specially indicative of the occurrence of diamonds. They have been found also in Sumatra, and from Australia a single diamond was brought over some years ago by Sir Thomas Mitchell.

With reference to the occurrence of diamonds in Brazil, I may refer you for the details of the subject to the admirable essay of MM. Heusser and Claraz, a French translation of which is contained in the *Annales des Mines* for 1860 (volume 18). The locality and the mode of occurrence of diamond in Brazil have been very critically investigated.

We will now consider the character of the chief rocks constituting the diamond district.

First of all, there is quartzite, a siliceous rock, to which the name of itacolumite has been given, from Itacolumi, the name of a town. This rock is described as a granular, friable, quartzose sandstone, smaller or larger in grain, and it often contains talc, chlorite, and mica. On a large scale it always presents a more or less distinct slatey or schistose structure, shewing clearly, or, at all events, indicating very strongly, its sedimentary origin. It is sometimes traversed by pyrophyllite, a beautiful talcose mineral like that occurring in the Ural. This quartzite in some places is found to be flexible. That is owing to the interposition of little micaceous scales. If we suppose that during the formation of a rock of this kind, particles of sand intermingled with mica constantly settling and going down with various degrees of rapidity—the particles of sand, perhaps, first constituting a small bed, which is then overlaid with little laminæ of mica, and then another bed of sand being deposited, and then laminæ of mica—we may get an idea of how this flexible rock has been formed. The flexibility is due to these little interposing laminæ of mica. Itacolumite is stated by geologists to be, beyond a doubt, a metamorphic rock—that is, a rock which has been changed materially subsequent to its deposition. It is said also to have been originally sedimentary. No fossils have been found in it. It is stated to resemble much the schistose quartzite near Breslau.

So much, then, for this quartzite, or itacolumite.

There is also a so-called metamorphic schist, which is very interesting in many respects. It is very variable in its characters, and contains quartz, sometimes associated with chlorite or talc, and sometimes with mica. In some localities it passes into a pure mica schist. As I said on the last occasion, no hornblende occurs in the varieties of this schist worked for diamonds. It generally forms elevated plains, and is easily weathered. It frequently passes insensibly into an argillaceous schist containing talc, mica, and disthene or cyanite, and also into itacolumite itself. In one locality fragments of crystalline schist form a conglomerate in the itacolumite. Limestone, and schistose red iron ore, and itabirite, as it is called, occur in the metamorphic schist. Itabirite is only a variety of the schistose red iron ore accompanied with quartz and mica. It sometimes forms thick beds of great extent, and when pulverulent it forms what is called jacotinga. The Gongo Soco mine is in such a bed. We have in the museum a very interesting case of diamonds with the associated minerals, to which I may refer you. The limestone also occurs in thick beds, in which are numerous caverns abounding with bones and saltpetre. The itacolumite and metamorphic schist generally occur inalternate beds.

As I said, the metamorphic schist is very easily disintegrated, sometimes being weathered, or decomposed, or softened to a great depth. It is said that the softening is due to the heavy tropical rains, reported to contain nitric acid after storms. In the products of the disintegration of the metamorphic schist and the itacolumite, as well as in the recent foundations derived from them, numerous rare minerals are found; and that is a very interesting point of our inquiry. First, we have the diamond: then that beautiful mineral, extremely rare and highly prized—the enclase; and also topaz, chrysolite, cymophane, transparent andalusite, tourmaline, amethyst, a beautiful variety of anatase and rutile.

Diamonds are met with in three distinct regions. First, they are met with in what is called gurgulho, which is derived from the itacolumite, and consists of a pure quartzose sand. This is washed, and with the diamond is obtained a residue of rutile, anatase, and magnetite. These more or less constantly accompany the diamond, and are regarded as an indication of its presence. As the minerals associated with the diamond are also found in itacolumite, it might be concluded with tolerable certainty that the diamond is derived from that rock. Moreover, the diamond occurs in most rivers rising in the midst of the itacolumite. This, then, was strong evidence; but we are now certain of the fact, because diamonds have been actually obtained by blasting an enormous rock of itacolumite, stamping and washing the fragments. One observer has seen four diamonds in the itacolumite in one spot. There is another variety of this gurgulho, formed from the metamorphic schist, in which the products are more or less mixed with those of itacolumite. As long as the superficial gurgulho yielded diamonds the exploration of the subjacent soft schist was never thought of; but in 1850, by chance, some of the schist was washed, and produced many diamonds. Ever since the schist which is derived from the metamorphic schist has been worked. No diamonds have yet been discovered in the metamorphic schist itself, but as yet it has not been properly *exploited*,—to use the French term. They, no doubt, are there, because we clearly find them in what are certainly the products of the weathering action of that schist. Observation has shown that the metamorphic schists—the richest in diamonds—are all of a grey or blackish colour, and are strongly impregnated with oxide of iron.

Then we find the diamond in the beds or on the banks of rivers, and these diamond workings are very extensive, and by far the most frequent. Generally the river beds are on the solid rock. This is covered with *débris* washed down from the adjacent mountains, forming the river bed, properly so-called. The material which forms this bed is called cascalho. This is the *débris* of the adjacent mountains which constitutes the river bed, and in this bed diamonds are frequently found. It is often covered with great blocks of itacolumite; and when hydrated sesquioxide of iron occurs in the vicinity it has cemented together the upper layers of this bed, and changed them into a conglomerate, which is sometimes so hard as to require blasting. This conglomerate not unfrequently contains diamonds. In the cascalho we find the united products of the weathering both of itacolumite and metamorphic schist. There is, therefore, no doubt whatever of the derivation of the diamond from the itacolumite and the schist, though it by no means follows that they should be uniformly found in these rocks. In the Brazilian cascalho, Damour has mentioned the occurrence of disthene, felspar, almandine, hydrophosphate of alumina, titaniferous phosphate of yttria—a very rare substance—diaspore, and tantalite, baierine [columite], oxide of tin, cinnabar, and, which is interesting—graphite—another variety of carbon. Gold is diffused in the Brazilian diamond-bearing schists, and also platinum. The association of gold with diamond is a very interesting fact.

In the Ural diamonds have been found since Humboldt's visit in 1829. He suggested the probable existence of diamonds there, from the geological similarity of the district to that of Brazil. The mountains are described as itacolumite passing into clay slate, talcose schist, and dolomite. The diamonds are found in a stream work a foot and a-half or two feet thick. Below is a bed of disintegrated dolomite, from two to five feet thick. In this, however, no diamonds have as yet been detected. The dolomite contains crystals of quartz and many fossils. The diamonds are associated with brown iron ore, specular iron ore, magnetite, anatase, and gold. A few diamonds have been found in a rock similar in all respects, apparently, to itacolumite, occurring in North Carolina and Georgia. It is a laminated, granular quartz. The lamination is said to be owing to the intermixture of a little mica. The diamonds occur in a river bed similar to that of Brazil.

I need not say more concerning the mode of the occurrence of diamonds. Now comes the question—and it is a question which has not yet received solution—if this itacolumite be, as there is no doubt it is, a rock of sedimentary origin, have the diamonds been developed in this rock subsequent to its deposition, or derived from the preexisting rock, out of which this secondary rock has been made? With regard to the possibility of making diamonds, scarcely a chemist is to be found who doubts that one day or other diamonds will be made. Numerous attempts have been made from time to time to produce them artificially, and the experiments have extended over several years; I recollect trying one myself for ten years, but the attempt proved abortive. One gentleman, especially, has devoted a great deal of attention to this subject, and he maintains most positively that he succeeding in producing a diamond; I asked him where the diamond was, but he stated that unfortunately during one of his investigations the diamond slipped out of his hand, and could nowhere be found, and he has not been able to produce another. Various experiments have been made upon bisulphide of carbon. We were informed a good many years ago that some French chemist had succeeded in making a diamond by plunging phosphorus into this liquid compound of sulphur and carbon, which has a high refractive power. It was said that in this way the diamond might be produced, the sulphur being taken away from the compound by the phosphorus and the carbon being set free in a crystalline form. Then, again, it has been attempted to decompose the bisulphide of carbon by means of silver; I kept a piece of silver in that liquid for ten or twelve years. The silver became blackened on the surface, which seemed to be an indication of decomposition, as though the sulphur were taken away so as to allow the gradual elimination of the carbon. Unfortunately it happened that this bisulphide of carbon operated upon had not been perfectly free from sulphur, and all that the silver did was to take out the sulphur which had been contained in that state of solution in the bisulphide.

I am sorry that I am not able to present to you a a definite account of the mode of making diamonds, affording you some clue to their formation. At present, candour compels us to say that we have no clue whatever, as far as I know, to the mode in which diamonds have been produced in nature; most certain it is that a high temperature has not been employed, because it loses its character at a high temperature. There are many unstable compounds of carbon now known, and which possibly may be produced one day by electrolytic action, and then we may hope to be able to generate this precious mineral—the diamond.

The next subject which I have to bring to your notice is one of great interest—namely, graphite, black lead, or plumbago. It occurs abundantly in nature, and is devoted, as you all know, to manifold uses. It is nothing more than a crystallised variety of carbon, but the system of crystallisation differs from that in which the diamond crystallises. Graphite is rhombohedral, and diamond is cubical.

The chemical properties of graphite have been carefully investigated of late by Professor Brodie, of Oxford. He has obtained some curious results, which are worthy of attentive study. Graphite occurs as a dark grey substance, having a more or less metallic lustre. It is soft, and may generally be scratched by the finger-nail. It produces the well-known mark of "black lead." It is perfectly infusible at the highest possible temperatures, and perfectly fixed, so far as we know. You may heat it as strongly as you like, applying the highest temperature possible, and yet not a particle of it shall be volatilised. It burns with great difficulty, requiring exposure to a high temperature for a long time, and on this account it is used with great success for making crucibles. You may take a graphite crucible, heat it for four or five hours in a white hot furnace, and yet it shall only burn very partially away. Of course some of the substance will disappear, but it will stand exposure for a very long time to a high temperature with access of air.

With regard to the mode of formation of graphite, we can produce it artificially, and sometimes obtain it beautifully crystallised. It is an accidental product of our iron furnaces. It frequently occurs there, and is known under the name of "kish." It exists in all grey pig iron. There is, indeed, reason to believe that grey pig iron—at least, if it could be got in a state of purity consisting only of carbon and iron, though I am afraid we do not get it in that state—would, in the solid state, be nothing more than malleable or wrought iron with carbon diffused through it, and that there is no combination, or scarcely any, at all events. There is a specimen taken from the bear, as it is termed—that is, a ferruginous mass occurring at the bottom of our iron furnaces. Here, again, I have another specimen—pounds of it altogether, taken from a blast furnace. Sometimes we obtain it, as I have said, very distinctly crystallised. When we bring malleable iron—that is, wrought iron—into contact with carbon—any kind of carbon—common wood charcoal, to wit—at a high temperature, they do combine undoubtedly. The carbon is taken up and dissolved by the iron, forming the various kinds of pig iron; but on cooling that carbon separates in a great measure, certainly, under ordinary conditions, in the state of graphite. That we can prove. We see the graphitic appearance of the fracture of pig iron. Then, by the action of acids, we can dissolve out the iron and obtain the graphite scales. I think that the solubility of this graphite in iron varies to a certain extent with the temperature. We can make iron take up very much more graphite at a high temperature than it can retain at a low temperature; therefore, you can understand how we can produce graphite in this way with the greatest ease. We have a variety of graphitic carbon which is generated in our covered gas-retorts. Everybody knows that in course of time these gas-retorts become covered with a firmly adherent deposit of difficultly combustible carbonaceous matter similar to graphite. In this case the carbon is separated by the action of a high temperature upon a hydrocarbon—some hydrocarbon developed during the production of the gas by the distillation of the coal. That is a common case. The carbon is always deposited in the graphitic state, having a high lustre. We may make graphite directly by the action of chloride of carbon upon molten pig iron.

I will throw out one suggestion on the formation of diamond again while upon this subject, before I proceed to consider the mode of the occurrence of graphite in nature. You will remember that when speaking of aluminium and silicon, I said that aluminium had the property of dissolving silicon, and that the silicon separated during solidification, and was obtained in the octahedral state. I said also that zinc has that property of dissolving silicon, and that aluminium has the property likewise of dissolving silicon. In the case of the aluminium, the silicon separates in the octahedral form; and in the case of the zinc the silicon separates in another crystalline state—the rhombohedral form. We have, then, two distinct kinds of crystals of silicon—the one produced from solution (if I may use the expression) in zinc; the other produced from solution in aluminium. Professor Wöhler has been working with the subject of calcium. He finds that that metal has the property of combining with carbon to a great extent. I do not know the exact conditions of these experiments, but if the combination should take place at a low temperature, it is just possible that we may get a similar action to what occurs in the case of silicon, and possibly the fused carbon might separate out of this calcium in another crystalline state. That is, of course, conjectural.

Graphite occurs in nature in granite, gneiss, mica-slate, and crystalline limestone. The crystals in the limestone are sometimes in the form of delicate plates, and I cannot understand how they could have got there; but there is the fact, and we must leave it as a problem yet to be solved. Graphite occurs also in greenstone, and in nests; in trap at Borrowdale, in Cumberland, and also at Arendal, in Norway, in quartz. I might also mention other places. I have here on the table a series of graphite, and a very interesting series it is. You can examine it hereafter.

The next variety of carbon need only be mentioned. It is the amorphous state of carbon, which is well represented to us by ordinary charcoal. It is perfectly non-crystalline. You see what a parallel series we have between carbon and silicon. There are two states of crystallisation in which silicon occurs, and then we have the amorphous condition. Here in the case of carbon we have two crystalline states—diamond and graphite, and the amorphous condition. It is not my business here to describe carbon. It is entirely a chemical question, and has no interest except from a chemical point of view.

We have to consider to-day the various of mineral fuel, or carbonaceous deposit, as I term them—certain kinds of coal, and certain other accessory carbonaceous matters. It is perfectly clear that all these carbonaceous matters have been derived originally from woody tissue. I shall not stay to attempt to establish that proposition. I must take it for granted. The evidence to be found in any geological book or any chemical book is so clear as to leave no doubt upon that point.

We must say a few words about wood. Wood consists essentially of carbon, hydrogen, oxygen, and nitrogen, together with what is termed inorganic or mineral matter—earthy matter. If we take a piece of charcoal and burn it away in the air, there will remain a white ash. That white ash is the mineral matter to which I allude. It consists of various so-called mineral ingredients. From the analyses of an extensive series of woods from various kinds of trees, and of different parts of those trees at different ages, I have deduced this as the average composition of wood:—

Carbon	51·22
Hydrogen	6·24
Oxygen	41·45
Nitrogen	1·10
Ash	1·77

This is information which we require in the consideration of the formation of coal, as you will see presently. There is always nitrogen in wood, though it was formerly supposed to be absent. I do not think I need trouble you much on the subject of the composition of the ashes of wood. They contain potash, and sometimes soda and silica, and so forth. We require a fresh series of analysis of the ashes of wood. There is also lime and magnesia. Alumina has been stated to be found in wood, but that I very much doubt. Then there is a small quantity of iron sometimes. Manganese has been found in the ashes of wood. There is also carbonic acid, derived no doubt from the incineration of some of the organic products existing in wood. There is phosphoric acid in every case. There is a little sulphuric acid found. Those are the chief constituents. The term potash—wood ash—indicates the origin of that substance.

I think it may interest you to record a few statements concerning the rapidity of the growth of wood in different localities, as bearing upon the formation of coal, or the rapidity of the growth and production of coal. I have collected some observations upon this subject from the papers of Chevandier, who has paid great attention to the subject, and whose papers you will find in the *Annales de Chimie*, published several years ago. He ascertained that on the western slope of the Vosges Mountains, and in the plain extending from their base, the average annual production of wood in forests of large beech trees is about 318 cubic feet per 2½ acres.* The average weight of dry wood annually produced in these forests amounts, in round numbers, to 8050 lbs. avoirdupois per 2½ acres. This contains 3968 lbs. of carbon, and 57 lbs. of hydrogen in excess of that required to form water with the oxygen of the wood. He has calculated that a bed of coal containing 85 per cent. of carbon, corresponding to the annual growth of these forests per 2½ acres, would have an average thickness of $\frac{8}{1000}$ths of an inch, or $\frac{84}{10000}$ths. The produce of coppice wood is much influenced by the nature of the ground. In coppices the ground is not so protected from the dessicating action of the sun and winds. In the Black Forest, in the duchy of Baden, trees of hornbeam, a common plant in this country, produce annually 5644 lbs. of dry wood per 2½ acres. Trees of the common silver fir produce 8264 lbs.

To be continued.)

ACADEMY OF SCIENCES.

May 9.

MM. Bussy and Buignet continued their memoir "*On Hydrocyanic Acid.*" In this part they study the action of the acid on the chlorides of mercury. They show in the first place, that the bichloride has a strong affinity for hydrocyanic acid, retaining it with power, although forming no definite chemical compound. The protochloride is converted into the bichloride, with consequent separation of mercury. They also study the action of various salts and substances on the aqueous solutions of the acid, and show that a great number have the power of separating, though in different degrees, the water from the acid, which in some cases forms a distinct layer on the surface of the mixture. This paper is altogether of so much importance that we shall at a future time present it to our readers but slightly abridged.

A memoir "*On the Manufacture of Fatty Acids for Candles and Soaps,*" by M. Mege Mouries, was presented. This memoir suggests, rather than details, a cheap and easy method of separating stearic and oleic acids and glycerine. The author shows that in the ordinary state tallow is saponified with difficulty, while in the globular state, which may be induced by melting the tallow in water containing a little soap in solution, a small quantity of alkali easily attacks it, and when the mixture is raised to about 60°C. the alkali and glycerine quickly separate. The fatty acids can now be separated by placing the soap in water acidulated with sulphuric acid, whereupon the stearic acid will crystallise, and the oleic acid be obtained almost colourless with the sulphate of soda, and can then be made into soap. This seems an important process for manufacturers, and deserves attention. No precise details are given, but the method is clearly indicated in the paper, which we shall translate in full. The memoir elicited the commendations of M. Chevreul, who considered the process ingenious and simple.

We do not meddle much with medicine, but we may mention here that a curious *case of diabetes* in a monkey was related to the Academy by M. Berenger-Feraud. The author brought two monkeys from Algiers, and in the hope of saving them from pulmonary consumption, tried to persuade them to live on a mixed diet of animal and vegetable food. One positively declined, and soon died of acute tuberculosis. The other adopted the mixed diet, and stood the cold well for a time, but unmistakeable symptoms of diabetes manifested themselves, and this monkey also died after a residence of nine months in France.

NOTICES OF BOOKS.

Journal für Praktische Chemie. Nos. 6 and 7. 1864.

The two numbers of the above-named Journal have arrived too late to allow us to give more than the titles of some papers. The former, however, contains two papers which merit an abridged translation; but this we must for the present defer. One is, "*On the Analysis of Silicates,*" by Werther. There is nothing very novel in the method given, but it may be useful in some instances. Another paper by Winckler, "*On Cobaltic Acid,*" leaves no doubt of the existence of this body, and corrects an error into which the author had fallen in a former paper. He then gave the formula of cobaltic acid as CoO_3; recent results have led him to adopt the formula CoO_2. The other papers in this number either have no interest for the generality of our readers, or have already appeared in the Chemical News.

The next number opens with the first part of a generally careful and accurate paper by Werther "*On Thallium,*" to which we shall return when it is concluded. A communication by Rammelsberg follows, "*On the Native*

Compounds of Vanadic Acid and Lead Oxide;" and we have a lively and interesting essay by Scheerer, entitled "*Has Silicic Acid the Composition* SiO_2 *or* SiO_3*?*" and in which the question is fully discussed in all its relations.

Poggendorff's Annalen der Physik und der Chemie. No. 4. 1864.

Among some valuable papers on various subjects in physics, we find in this number an account by Weyle of some *metallic ammonium compounds*, which will interest the reader. The author appears to have obtained some curious compounds of ammonia with potassium and with sodium, and also with sodium amalgam. The potassium compound he describes as an ammonium in which the fourth equivalent of hydrogen is replaced by potassium.

$$\mathrm{N}\left\{\begin{matrix}\mathrm{H}\\ \mathrm{H}\\ \mathrm{H}\end{matrix}\right.\\ \quad\mathrm{Ka}$$

The paper presents several novelties, and merits translation at length.

Other papers—"*On the Formation of Ice in the Sea,*" "*On the Theory of the Leyden Jar,*" and "*On the Theory of Light,*" are of that recondite character which makes them so valuable to the readers of *Poggendorff.*

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 16, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

999. Henri Adrien Bonneville, Rue du Mont Thabor, Paris, "A new method of obtaining a semi-fluid or solid product obtained by concentrating the saponaceous parts of the quillai tree."—A communication from Emerie de Werchin, Maubeuge, France.—Petition recorded April 21, 1864.

1021. James Edward Duyck, Stamford Street, Blackfriars, London, "Improvements in treating petroleum and other hydrocarbon oils and fats or fatty bodies."—Petition recorded April 22, 1864.

1058. Bonnet Frederic Brunal, Brussels, Belgium, "Improvements in treating titanic iron sands, and in apparatus employed therein."—Petition recorded April 27, 1864.

Notices to Proceed.

3294. Jean Michel Vanderfeesten, Brussels, Belgium, "Improvements in apparatus for heating, boiling, evaporating, and distilling."—Petition recorded December 30, 1863.

3307. John Dale and Heinrich Caro, Manchester, Lancashire, "Improvements in obtaining colouring matters for dyeing and printing."—Petition recorded December 31, 1863.

10. Jean Louis Prosper Duroy, Faubourg Montmartre, Paris, France, "An improved method of manufacturing soap with a vegetable basis.

16. William Balk, Woodbridge Road, Ipswich, Suffolk, "Improvements in furnaces applicable in the smelting of ores and in the melting of metals."—Petitions recorded January 2, 1864.

192. Frederick North, Leeds, Yorkshire, "Improvements in processes and apparatus for treating and preparing peat and turf, and the products obtained therefrom"—A communication from Charles Fluery, Bruxelles.—Petition recorded January 23, 1864.

225. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in stopping bottles containing aerated liquids."—A communication from Edward Hamilton, Chicago, U. S.

263. William Clark, Chancery Lane, London, "Improvements in effecting the combustion of certain matters for heating purposes, and in apparatus for the same."—A communication from Francis Bernard de Keravenan, Boulevart St. Martin, Paris.—Petition recorded January 30, 1864.

283. Edward Beanes, Argyle Street, London, "Improvements in preparing or treating animal charcoal."—Petition recorded February 3, 1864.

292. Henry Edwin Drayson, Southampton, Hampshire, "An improvement in the manufacture of gunpowder."—Petition recorded February 4, 1864.

512. William Ibotson, Wraysbury, Middlesex, "Improvements in the manufacture of paper and in machinery employed therein."—Petition recorded March 3, 1864.

925. Frederick Albert Gatty, Accrington, Lancashire, "Improvements in treating garancine and other products of madder."—Petition recorded April 27, 1864.

CORRESPONDENCE.

Bankers' Cheque Paper.

Mr. Barclay, the patentee of the cheque paper mentioned by Mr. Heaton in No. 225 of the Chemical News, makes the following statement:—

That he is prepared to show that the process pointed out by Mr. Heaton for the evasion of the security of his patent cheque paper is *not* (as stated by Mr. Heaton) successful.

That, in combination with other means in ordinary use in printing and preparing bank cheques, his paper offers the best method of protecting a cheque from an alteration by chemical reagents which has hitherto been brought into *practical use*, and that the principles thus involved are sanctioned by some of our best chemists when required to give their views a practical form; but that he cannot enter into the question until the controversy in the *Bankers' Magazine* has closed, and that he has there stated that the attack there made upon him was founded on a failure of the parties in question in a fair trial, before a banker, successfully to extract portions of writing from certain cheques furnished and fully approved by him.

MISCELLANEOUS.

YOUNG *v.* FERNIE.

This was a trial for an alleged infringement of a patent. It is within the knowledge of most of our readers that in December, 1850, Mr. James Young took out a patent for "Improvements in the treatment of certain bituminous mineral substances, and in obtaining products therefrom." The specification proceeds to describe the invention as consisting in treating bituminous coals in such a manner as to obtain therefrom an oil which the patentee calls paraffine oil, and from which he obtains paraffine. The specification continues:—"The coals which I deem best for this purpose are such as are usually called parrot coal, cannel coal, or gas coal, and which are used in the manufacture of gas for the purpose of illumination, because they yield upon distillation at a high temperature olefiant and other highly illuminating gases in considerable quantities; and although some coals last described contain a large amount of earthy matters, those matters do not interfere materially with my process. To obtain paraffine oil from coals, I proceed as follows:—The coals are to be broken into small pieces of about the size of a hen's egg, or less for the purpose of facilitating the operation. The coal is then to be put into a common gas retort, to which is attached a worm pipe, passing through a refrigerator, and kept at a temperature of about 55° F. by a stream of cold water. The temperature of the refrigerator should not be kept too low, lest the product of the distillation should congeal and stop the pipe, and I find that a temperature of about 55° F. is sufficient. The retort being closed in the usual manner, is then to be gradually heated up to a *low red heat*, at which it is to be kept until volatile products cease to come off. Care must be taken to keep the temperature of the retort from rising above that of a low red heat, so as to prevent as much as possible the products of the process being converted into permanent gas." Much of the remainder of the specification is unimportant to the present case, and we only extract a few more sentences. As regards the temperature to be employed it is further stated:—But in order to obtain the largest quantity of crude paraffine oil from coals by means of this process, and produce the smallest quantity of permanent gas by the action of the heat employed, whatever may be the apparatus used, care must be taken to heat the coals gradually, and to employ the *lowest temperature* necessary to complete the operation. Then after describing the method of purifying the paraffine, the specification concludes as follows:—" Having thus described the nature of my invention, and the best means with which I am acquainted for performing the same, I hereby declare that I claim as my invention the obtaining of paraffine oil, or an oil containing paraffine and paraffine from bituminous coals by treating them in the manner hereinbefore described." Such is the patent alleged to be infringed. The defendants, as we gather from the speech of Mr. Grove, assert a want of novelty in the invention; and, further, that they obtain their oil at a lower temperature than a low red heat—the temperature specified; but this will appear in the evidence. It is unnecessary to say that we shall confine ourselves entirely to the chemical evidence, and give this in as condensed a form as possible. The first witness called was Dr. Hofmann,* who, in his examination in chief, stated that he knew Mr. Young's process, and was acquainted with the substances paraffine and paraffine oil. Paraffine he knew as a scientific curiosity before 1850, but did not at that time know that it could be produced from coal. Mr. Young has stated the coal to be employed in the manufacture, and the heat to be employed. The heat is to be applied gradually up to low redness. Low redness may be said in round numbers to lie between 800° and 1000° F. —a heat which just becomes visible in the dark. It is well known and distinguished from a bright or cherry red. In the distillation the condensing tubes must be kept moderately warm to prevent the solidification of the paraffine. The product of the distillation is an oily substance called paraffine oil, which deposits a solid substance paraffine, held in solution by the oil. These products arise from the exposure of a peculiar coal mentioned in the patent to a temperature mentioned in the patent. At a lower temperature than that mentioned you would get none, or only very little of these products. At a higher temperature you would get gaseous products and others, which differ from paraffine and paraffine oil. Gas and tar are obtained above 1000° F. Paraffine can be got from tar in minute quantities, but not commercially. Crude paraffine oil and tar differ essentially in their properties, both physical and chemical. No one to my knowledge obtained paraffine and paraffine oil for commercial purposes from coal before Mr. Young. Since then the subject has attracted much attention, and the article has become of great commercial value. I have read a good deal about paraffine, and can state that before 1850 it was only known as a chemical curiosity. No practical mode of obtaining it was known before that time. I believe Mr. Young's invention was new at the date of the patent, and that any workman by following the directions of the specification could produce paraffine and paraffine oil. I am aware that before 1850 other persons had attempted to produce paraffine from peat, from schist, and, I believe, from tar; but, according to my belief, had not succeeded in producing it from coal. At certain temperatures above a low red heat naphthaline and paraffine are produced together. I know no practical mode of separating these bodies. Naphthaline is not practically produced in Mr. Young's process. Naphthaline is produced in the manufacture of gas. Paraffine may be regarded as olefiant gas in a solid form; at a high temperature paraffine oil may be converted into gas, but at present chemistry has not practically enabled us to convert gas into paraffine. I have looked at a number of documents which have been placed in my hands, and am prepared to answer any questions put by the defendant's counsel.

Cross-examined by the Attorney-General: I know that paraffine had been obtained from coal before Mr. Young produced it. The description in Mr. Young's patent includes a considerable variety of coal—all bituminous coals. Gas coal may be taken to mean coal from which gas is made for commercial purposes, such varieties of coal as from their yielding large quantities of olefiant gas are particularly desirable for a gas manufacturer. The term "gas coal" I understand to apply only to such as give large quantities of olefiant gas. There are other illuminating gases which have the power of producing the oil, propylene, butylene, amylene, and several others, which, for practical purposes, are comprised under the term olefiant gas. Marsh gas would practically be comprehended in the term. According to our present knowledge, we attribute the highly illuminating power of coal gas to olefiant, and the other gases I have mentioned which have the same composition as olefiant gas. I believe all gas coals are fit to produce, for profit and commercially, paraffine and paraffine oil by Mr. Young's process. I am not practically acquainted with any Newcastle coal which will produce paraffine oil commercially by the process. I have never seen any coal distilled but that I distilled myself, which was Boghead. This is a peculiar kind of coal. A great variety of similar coals are known. It has been discussed very considerably whether Boghead coal should be classed as a coal or a shale. There is a great difference in the appearance of Boghead and Newcastle coal. The former resembles in some points Dorsetshire shale. I distilled specimens of Dorsetshire shale, and found that they yielded oil, but only minute quantities of paraffine. Boghead coal yields a much larger quantity. Those coals which yield a highly illuminating gas will yield a larger proportion of paraffine. I cannot say, without analysing it, whether the specimen handed to me is Boghead mineral. It keeps a white stroke when scratched, which is characteristic of Boghead. Boghead mineral is found in direct connection with what is commonly termed coal. [The Attorney-General handed up another specimen, showing, he said, the point of junction of one coal passing, as it were, into the other.] In this second specimen there is considerable difference in the two scratches; one is white, the other black. It may be that this would naturally happen with respect to that portion of the Boghead which lay next the coal. I believe in many cases beds of shale pass into beds of coal. The shale I received from Dorsetshire in some respects resembled, and others differed essentially from Boghead coal. It is not always easy to distinguish coal from shale. I am not certain at what temperature I distilled Dorsetshire shale, but I remember distinctly that it was considerably above the fusing point of lead (620°). The products I obtained were in many respects like those procured from Boghead cannel. I distilled three specimens, and obtained different quantities of mineral and volatile matter. No. 1 contained 80·49 mineral matter, and 19·52 volatile; No. 2, 47·2 mineral, and 52·8 volatile; and

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* Dr. Hofmann, as the principal witness for the plaintiff, was under examination three days. Our report will necessarily be a mere abstract of his evidence, but it is given in the first person to avoid a troublesome circumlocution.—Ed. *C. N.*

No. 3, 26 mineral and 73·3 volatile matter. Of the volatile matter, a portion was oily, and a portion gas and water. In the lowest instance 100 parts of shale yielded 14·6 parts of oily matters. In another experiment this quantity rose. When ordinary coal is distilled the quantity of mineral matter found varies. Carbon is a mineral matter—a mineral component of vegetable matter. In the analyses spoken of I mean fixed mineral matters, all the carbon being burnt. I saw paraffine candles in the Exhibition of 1851; they were made from schistus. I did not see the schistus. A white mark left when a specimen is scratched with a knife indicates a considerable quantity of mineral matter. Ordinary coal does not usually leave a white mark. I would endeavour by distillation to ascertain whether a substance was coal or shale. Coal on distillation leaves coke behind; Boghead material leaves coke behind, but it is an inferior coke, and yet a *bonâ fide* coke, which will burn in atmospheric air—not mere ash. I am not certain that I have burnt it. Coals vary to a great extent, and from my notes I find that the quantity of ash in *bonâ fide* coals varies between one-half per cent. and 30 per cent. The proportion of ash is not least in the more highly bituminous coal. In anthracite coal you have occasionally very minute quantities of ash. In cannel coal the proportion of ash is large. [The examination here related to the physical differences between cannel coal, ordinary coal, and schists, and the witness remarked that he must confine himself to his own department of science.] It is difficult to tell the coal from shale; the two substances are so allied that it is only by a sort of compound analysis that I, as a chemist, have formed an idea of the difference. One of the most striking characteristics of shale and schist is the formation during distillation of a large quantity of nitrogenous volatile compounds, distinguished by their repulsive odour. A chemist is a bad judge of odour; he gets so many; still, I would say that the odour of Boghead is eau-de-Cologne, when compared with the odour evolved in the distillation of schist. My attention has been drawn to the specification of Du Buisson, 1845. [The patent is entitled "Furnaces apparatus, and processes for the distillation of bituminous substances, and treating the products thereof," and the specification describes furnaces and apparatus for distilling bituminous schistus, and obtaining—1, a liquid bitumen, or raw oil of schistus; 2, a light oil which may be burnt in lamps; 3, a greasy oil for lubricating, and containing paraffine; and lastly, 4, paraffine itself.] The paraffine in this process appears the same as obtained by Mr. Young; the oils may be different, similar in appearance and application, but different in composition. So few chemical properties are given that it would be impossible to identify them with Mr. Young's. The description, as far as it goes, is very similar to Mr. Young's. There are differences in the two processes and the materials. Du Buisson describes schistus as consisting of animal and vegetable remains, and in the process steam passed through red-hot pipes and a red heat are employed. Steam passed through a red-hot pipe would become red hot. Mr. Young used a low red heat, and we distinguish between a red heat and a low red heat. By exceeding a low red heat some of the useful products would be transformed into gaseous matters and naphthaline. The quantity of paraffine and paraffine oil is diminished as the temperature is raised; but the absence of naphthaline would not be a criterion that the process had been carried out at a particular temperature. If the products are identical, I should infer that the materials used and the processes were the same. Different substances may require different temperatures. Different coals might require different heats, and so might shales. My attention has been called to Hompesch's patent, 1841. [This was a patent for obtaining oils from bituminous matters, such as schiste, clayslate, and asphalte. The specification describes an apparatus in which the material is gradually heated from 100° R. (257° F.) to 200° R., and subsequently to a red heat. In this way three separate oils are to be obtained—an essential oil, an intermediary or fat oil, and a thick oil.] It would be impossible to say whether these oils are the same as Mr. Young's. I would say they are not, because I find that the patentee describes particular processes for removing smells from this oil. The oils from schist have a very bad smell. Some people object to the smell of those from coal; but I would not compare the odour of the crude product from Boghead coal to that of the crude product from schist. In the process of De Hompesch there is a gradual raising of temperature to a red heat. Taking the process described by De Hompesch, I believe the products would be different from Mr. Young's. In the first place, the former collects the products in three different parts. He collects the first at 100° R.; if Boghead was exposed to this temperature nothing whatever would be obtained. In the second stage of the operation. the charge is maintained at a temperature of 200° R.; and I have no hesitation in expressing my belief that at that temperature Boghead would give out nothing whatever. Lastly, he pushes forward the charge to that part of the retort which is maintained at a red heat; and at that temperature the results would be entirely different. Paraffine and paraffine oil would, in fact, be destroyed at that temperature with the formation chiefly of gas and naphthaline, and the resulting products would be inapplicable to the purposes for which Mr. Young employs paraffine and paraffine oil. The apparatus, as described, involves the necessity of a passage from a lower heat to a red heat, but it is obvious that the products pass through a red heat, and that they are decomposed, and that I consider an essential difference between the statement of Mr. Young and Count de Hompesch. The first part of the latter's retort is to be kept at 100° R., the second at 200° R., and the third is kept at a red heat. It is obvious that as the heat is applied to the same apparatus, there must be a point of transition between 200° R. in the second compartment, and 1000° or 1200° (F.) of the third compartment. But it is distinctly stated that the third compartment is to be heated until it becomes red hot, and therefore I do not know at which point the material is kept at a *low red* heat. I would say that at a certain section of the retort it must traverse a *low* red heat, but the compartment itself, as I read the specification, is to be kept at a red heat. Hompesch's oils must be essentially different from Mr. Young's, since they are obtained at temperatures at which I believe Mr. Young's are never procured. The temperature of the second compartment (200° R.) is so low that you might expose Boghead coal to it for a fortnight without expelling a trace of oil. Coal tar is an ill-defined substance; what is generally called by the name is a secondary product obtained in the distillation of coal for gas. Such tar generally contains naphthaline. I do not know that the term has been applied to the substance which Mr. Young produces, or to a similar product either here or on the Continent. I am acquainted with the works of Reichenbach, and have had my attention called to extracts from them. [Reference was then made to an experiment in which Reichenbach distilled coal and obtained ammoniacal water, and what he called empyreumatic oil or *coal-tar*.] There is nothing in the passage quoted to show that Reichenbach's product corresponded with Mr. Young's crude oil. Nothing is said about the oil depositing paraffine, which Reichenbach would certainly have mentioned. The empyreumatic oil may or may not have contained paraffine, but it is not stated in the passage. Whether it did contain paraffine would in a measure depend on the kind of coal submitted to distillation. I cannot say whether there are any bituminous coals from which no paraffine can be obtained. [Another passage from Reichenbach's work was here read, in which he again speaks of the product obtained by distillation as *coal-tar*, and mentions that in the rectification of the tar the first half of the distillate was a thin liquid oil, and the second half a thick oil containing paraffine.] This passage proves that Reichenbach first discovered that paraffine could be produced by the destructive distillation of coal. He states that paraffine is a product of the carbonisation of all organic substances, and he had obtained it from various woods, from coal, and from Dippel's oil. [Another extract was now read, in which Reichenbach gives instructions for obtaining the "tar" without naphthaline. He states that the vessel in which the coal is distilled must never be allowed to become red hot. In this way he says he always obtained "tar" composed of piccamar, eupion, creosote, paraffine, moder, and sulphur, but never naphthaline. Above redness he always obtained some naphthaline.] The product obtained by Reichenbach would be similar to Mr. Young's if similar coal was employed. Purified paraffine oil is not the same as eupion, which, according to Reichenbach, is a well-defined chemical compound, having a constant boiling point of 336° F., while Mr. Young's oil boils between 280° and 550° F. From this I would give it as my deliberate opinion that Mr. Young's oil cannot be identical with eupion. I should say that eupion is not the principal constituent of Mr. Young's oil, which, I believe, is composed of a number of substances identical in composition with paraffine, and other substances which differ from the composition of paraffine by containing a slight quantity of hydrogen in addition. In the purified paraffine oil there is still some paraffine; I would venture to undertake the separation of more or less from all the paraffine oils in commerce.

(To be continued.)

Pharmaceutical Conversazione. — On Tuesday evening the President and Council of the Pharmaceutical Society received a large company at their rooms in Bloomsbury Square. Many objects of great interest were displayed in the rooms. In one was a collection of living exotic medicinal plants, amongst which we noticed a very flourishing specimen of the *Physostigma Venenosum*. In the library was a large collection of electric telegraphic apparatus and other objects of interest. In the lecture-room Mr. Abel gave a short lecture on gun-cotton, Mr. Ladd showed acoustic figures on the screen, and Mr. Claudet took a photograph by means of the light from burning magnesium wire. The *conversazione* was well attended, and the guests were extremely gratified.

Pepsine from the Pancreas.—A lecture by Dr. Corvisart contains a hint for the makers of pepsine. The Doctor removed the pancreas from a man who died suddenly after inhaling chloroform, cut it into small pieces, and shook them up with 400 grammes of cold distilled water. After filtration, one portion of this liquor was rendered slightly acid with hydrochloric acid; another portion was made alkaline with potash, and the third part was left as it was. The digestive power of each was then tested with fibrin and albumen, the mixture being kept at about 40° C., and in every case the digestion was rapidly effected.

How to View the Sun through the Telescope.—To use the full aperture of the telescope is of paramount necessity either in viewing the sun or planets. If the extinction of the light is effected by coloured glasses, the best combinations I have yet found are—first, that of two plane glasses of a shade between brown and violet, with one of a grass-green hue interposed; or second, of two green glasses, with a blue one coloured by cobalt between them. These allow scarcely any rays of the spectrum to pass but the yellow and less refrangible green; and they cut off almost all the heat. The perfection of vision is attained by using only the extreme red rays; but glasses which transmit these cannot be used on account of the heat they allow to pass. Whatever combination of glasses be used, they are, however, apt to crack and fly to pieces through the heat which they do intercept.—*Sir John Herschel in the Quarterly Journal of Science.*

Action of Fire on a Corpse.—When fire is applied to a living body a blister filled with liquid is soon raised, and if the heat be continued the epidermis is destroyed. But when the same heat is applied to a dead body the epidermis rises in the form of a blister, which is filled with vapour, and which presently bursts. This test has been proposed by M. Martin de Cordoux, to ascertain whether a person is really dead before the body is interred. In performing the test, the author recommends a small flame, such as the flame of a match, to be applied for a short time at about half a centimetre from the skin.

Poison Bottles.—Poison bottles and poison corks, poison caps and poison stoppers, have all successively been tried, with the object of preventing careless or sleepy nurses from giving medicines out of the wrong bottles and thereby poisoning their patients; but they are all open to the objection that when the liquid for which they have been originally used is exhausted, the very nice-looking bottle is generally replenished with eau de cologne, tincture of senna, or such like innocent compounds, and the object of having a peculiarly-contrived bottle is thereby defeated. Perhaps the most unobjectionable of all these attempts to substitute a mechanical contrivance for ordinary caution and common sense, has been recently brought forward by Mr. Thonger before the Pharmaceutical Society. It consists of a patent label having a border of sand-paper round it, thus appealing strongly to the sense of touch, which is presumed will warn the holder that danger is near. These labels are applicable to dispensing bottles and to the smallest phials, and possess an advantage over any other contrivance, as they can be stuck on any vessel, and as readily removed when the poisonous contents are done with, and the bottle is required for something else.—*Chronicle of Chemistry in the Quarterly Journal of Science.*

Movements of Clouds.—M. Andrès Poey has addressed a letter to *Les Mondes* on the azimuthal rotation of clouds. He states that he hopes to be able to demonstrate that the law of the rotation of winds put forth by M. Dove is perfectly applicable to clouds, and that it is even the rotatory direction of clouds which determines the rotation of the wind beneath and modifies the general meteorological phenomena. He gives the law of M. Dove as follows:—"1st. When upon the north hemisphere the currents of air coming from the equator alternate with the polar currents, the wind makes the tour of the compass most often in the direction of south, west, north, east, and south. 2nd. In the southern hemisphere it is the reverse, namely, south, east, north, west, and south. 3rd. The influence of the wind on the meteorological phenomena, combined with the law of its change, affect two opposite halves of the compass under all relations, the region of the east and that of the west, in which the atmospheric variations present a correspondence which it is easy to observe." In order to establish the circular movements in the atmospheric currents, he eliminated all the clouds of transformation which would have masked the general result of the circulation, and all the partial and isolated rotations of the wind, as also the effects of the sea-breeze. He attempts the explanation of the occurrence of rain and of other meteorological phenomena.

ANSWERS TO CORRESPONDENTS.

J. T. B.—The balance was made by Lard and Oertling specially for us.

M. P. S.—We shall give attention to the subject.

E. B.—The bill, it is said, will be presented to Parliament this session, but is not likely to receive much attention this year.

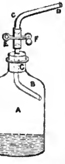
Erratum.—Last number, p. 230, in the formula of atropine and tropine, *for* Ag *read* As.

Received.—A. W. Whitelaw; W. S. Gibbons.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

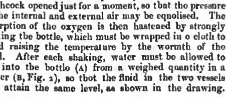
On the Volumetric Estimation of Tannic and Gallic Acids, Iron, Manganese, &c., by MORITZ MITTENZWEY.*

THE known disposition of tannic acid in alkaline solution to absorb oxygen from the air affords an excellent means of estimating this body for technical purposes. The estimation can be conveniently made in the simple apparatus here figured and described.



The air in a bottle (A), capable of holding about a litre and a-half, communicates with the atmosphere by the bent tubes (B) and (C), the latter being drawn out at the end (D) to the diameter of about one or one and a-half millimetres. The two glass tubes are united by means of a moderately long piece of india-rubber tubing (E), provided with a pinchcock (F) to close it; and the lower glass tube is fixed in the neck of the bottle by a bored cork, or, better, a caoutchouc stopper (G).

In executing the analysis it is absolutely necessary that the air in the bottle should be perfectly renewed, and the temperature of all reaching the fluid be the same as that of the laboratory. As soon as the absorbing lye (which should amount to 150 or 250 c.c.) is prepared, the bottle should be perfectly closed, and then the pinchcock opened just for a moment, so that the pressure of the internal and external air may be equalised. The absorption of the oxygen is then hastened by strongly shaking the bottle, which must be wrapped in a cloth to avoid raising the temperature by the warmth of the hand. After each shaking, water must be allowed to flow into the bottle (A) from a weighed quantity in a beaker (B, Fig. 2), so that the fluid in the two vessels may attain the same level, as shown in the drawing.



The experiment is ended when, after repeated shakings, no more water runs from B to A, and the difference in the weight of the water in the beaker *in grammes* gives the amount of oxygen absorbed in cubic centimetres, which can be corrected for the standard temperature and pressure.

I. For Gallic and Tannic Acid.—Place in the bottle about 200 c.c. of a 3 per cent. potash or soda solution, then drop in one gramme of tannic or gallic acid loosely wrapped in paper, and proceed as above described. The absorption is at first rapid, and in the case of gallic acid is soon complete; with tannic acid a longer time is required.

One gramme of tannic acid will absorb the same amount of oxygen as 0·7 gramme of gallic acid, namely, 175 c.c. at 20° C. In twelve experiments the greatest variation in the case of tannic acid amounted to only 2 c.c., and with gallic acid only 1·2 c.c. From six to ten experiments can be carried on simultaneously with ease, and indeed with advantage.

The best alkaline solution to use is a soda solution containing 2 or 3 per cent. of caustic soda, or a potash solution with from 3 to 5 per cent. of the caustic alkali. Experiments have proved strong solutions to be useless; for example, one gramme of tannic acid in a potash solution containing 35 per cent. of alkali only absorbed 22 c.c. of oxygen. Further experiments confirmed this unexpected result.

It has been already remarked that gallic acid absorbs oxygen with much greater readiness than tannic. One gramme of tannic acid, after shaking for 60 seconds, only absorbed 23·4 c.c.; while 0·7 gramme of gallic acid, after shaking for the same time, absorbed 71 c.c. of oxygen, the same proportion of each acid taking up when the absorption is complete one and the same volume (175 c.c.). We have here an indication of a means of estimating the two acids in the presence of each other. Suppose, for example, we have a substance, 2 grammes of which absorb 140 c.c., this will answer to $\frac{140}{175} = 0·800$ grammes of tannic acid, or to $\frac{140}{175}.0,7 = 0·560$ of gallic acid. For a second and decisive experiment, we now weigh as much of the substance as should combine with 175 c.c., in this case 2. $\frac{175}{140} = 2·500$ grammes, and shake this strongly with the lye for 60 seconds. Suppose, after this, we have 40 c.c. absorbed, we have then a decisive proof of the presence of both acids, and we can draw a conclusion as to their respective proportions.

It must be observed that in these experiments an equal weight of the substance, equally strong alkaline solutions, and a flask of equal size, and of similar form (about 1·4 litre capacity), are indispensable conditions.

The following table, which gives the means of the numbers obtained in three experiments after shaking for sixty seconds, show sufficiently concordant results:—

1·000	grammes	Tannic acid	absorbed 23·4 c.c.
0·000	,,	Gallic acid	
0·900	,,	Tannic acid	,, 27·5 c.c.
0·070	,,	Gallic acid	
0·570	,,	Tannic acid	,, 44·0 c.c.
0·300	,,	Gallic acid	
0·800	,,	Tannic acid	,, 61·0 c.c.
0·560	,,	Gallic acid	
0·000	,,	Tannic acid	,, 71·0 c.c.
0·700	,,	Gallic acid	

A rather roundabout but quite conclusive experiment may be made in the following way:—The mixture to be estimated is dissolved in a known quantity of water, and the tannic precipitated by gelatine; the gallic acid solution is then transferred to the absorption bottle to be estimated. A second experiment is then made with the mixture, and so all necessary data for the calculation are obtained.

In making use of the process to determine the tannic acid in leather, gall nuts, sumach, bark, &c., we proceed in the same way as with pure tannin. If the amount of tannic acid usually present in the substance is not already known, it is advisable to make a preliminary experiment with a small quantity, and afterwards proceed with the quantity calculated to absorb 175 c.c. By a parallel experiment made with one gramme of tannin and shaking for 120 seconds, the amount of gallic acid will be discovered.

This method of analysis is only available for the ordinary commercial substances. Whether all the so-called tannic acids have the same capacity for the absorption of oxygen as ordinary tannic acid is as yet undetermined.

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* *Journal für Prakt. Chemie*, No. 2, 1864, p. 81.

To Estimate Tannin in Leather.—From 4 to 7 grammes of the leather is cut into the thinnest possible slices, which are digested in about 200 c.c. of warm water; after cooling from 7 to 10 grammes of stick potash wrapped in paper is dropped into the flask, and the shaking proceeded with.

With *sumach and oak bark* the same method is followed, or a hot-filtered decoction is used. The results with the decoction always differ from those with the substance itself, the latter being higher, which seems to show that a portion of the tannic acid withstands the solvent action of the water.

Gall nuts, catechu in powder may be estimated in the same way as pure tannic acid.

II. Iron Compounds.—These must be reduced to the state of protoxide by means of zinc, and the excess of acid neutralised with caustic potash or soda. (Ammonia and the carbonated alkalies must be avoided.) The solution is then poured into the absorption-flask and pieces of potash wrapped in paper are then dropped in. The absorption is complete in a very short time. For accuracy this process is second to none, and may be recommended in preference to that of Margueritte and Fuchs, since it requires fewer precautions. 50 c.c. of a solution of protoxide which contained 1·395 Fe absorbed in three experiments 148·0 c.c., 148·44 c.c., and 148·4 c.c. of oxygen at 19° C.; the mean = 148·28 c.c., which at this temperature weigh 0·1987 grammes, answering to 1·391 grammes of iron.

III. Manganese Compounds.—As these are easily reduced to the state of protoxide, the estimation is made in the same way as in the case of protoxide of iron, but it is necessary to know to what extent the protoxide of manganese unites with iron. Further experiments are required to determine this point, and the following proportional numbers are only the results of some few experiments that have led to the conclusion that one part by weight of absorbed oxygen corresponds to 4·34 parts by weight of manganese, which may be calculated as the oxide Mn_3O_4. In the absence of more complete researches it is superfluous to discuss the rational formula of the resulting oxide; but one thing is certain—namely, that the oxidation does not proceed so far as the state of binoxide.

The estimation of manganese in the presence of iron is performed in two operations—one with the iron in the state of protoxide, and the other with the iron in the state of peroxide, and the absorption observed in the two cases. The combination of the two results will give the desired explanation.

Active oxygen may be estimated in a similar way, by means of a solution of protoxide of iron.

Indigo may be valued in the following way:—In a well-closed glass bottle finely-powdered indigo is reduced by means of potash or lime and a protosalt of iron, under a layer of mineral oil. When the precipitate has completely deposited, a certain volume of the clear solution of indigo-white is removed by means of a pipette, care being taken that a layer of oil swims on the surface of the solution. The pipette is then emptied into the absorption bottle, which must also contain oil, and the shaking is continued until the indigo blue is re-formed.

According to theory, 8 parts by weight of combined oxygen answer to 131 parts of indigo blue; or, for one gramme of indigo blue 45·7 c.c. of oxygen at 20° C. are required. From these numbers we may see at once what degree of accuracy this way of analysing indigo promises.

TECHNICAL CHEMISTRY.

Conversion of Salt Meat into Fresh; a further Application of Dialysis, by A. A. Whitelaw.

As an appendix to the notice of my process for the utilisation of brine (published in the Chemical News for March 26), I now beg to direct attention to a modification of that process, applicable to ships at sea, by which the quality of the meat supplied to the men may be much improved, and their food varied.

The salt meat is placed in a dialytic bag made of untanned skin, or other suitable material, and the bag filled nearly, but not quite, full of brine from the beef barrel. The dialyser is then placed in sea water, and the process allowed to go on for several days, till the meat and brine are sufficiently fresh for use, or till the brine in the dialytic bag is within 1° or 2° of Twadde's hydrometer of the same strength of sea water. In this way, as the brine becomes freed from salt, the beef, which, by the action of salt, has been contracted, gives its salt to the brine in the bag, and so the process goes on, the beef expanding like a sponge, and gradually taking up a great part of the natural juice that it had previously lost in the salting process. In this way no loss of juice is sustained by steeping, and the brine left in the bags, after a nightly dialysis in fresh water, can be used for soup.

Thoroughly salted beef, without bone, takes up nearly one-third its weight of juice, and this absorption takes place gradually as the strength of the brine in the dialyser becomes reduced.

Meat thus treated—being, in fact, fresh meat—may be cooked in a variety of ways that are obviously not available for salt meat; and so the food of sailors, and, consequently, their health, may be improved.

55, Sidney Street, Glasgow.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 15, 1864.

"*On the Chemical History and Application of Gun-cotton,*" *by Professor* Abel, *F.R.S., Chemist to the War Department.*

The history of gun-cotton affords an interesting illustration of the facility with which the full development of a discovery may be retarded, if not altogether arrested, for a time, by hasty attempts to apply it to practical purposes before its nature has been sufficiently studied and determined. When Schönbein, in the autumn of 1846, announced that he had discovered a new explosive compound, which he believed would prove a substitute for gunpowder, the statement attracted general attention, and attempts were made with little delay in different countries to apply the material to purposes for which gunpowder hitherto had been alone used. Schönbein, and Böttger (who appears to have discovered gun-cotton independently shortly after the former had produced it) lost little time in submitting their discovery to the German Confederation; and a committee was appointed for its investigation, by whom gun-cotton was eventually pronounced inapplicable as a substitute for gunpowder.

In this country, gun-cotton was experimented with immediately after the method of its preparation was published by Schönbein. Researches were instituted into its nature, preparation, &c., by Porrett and Teschemacher, John Taylor, Gladstone, and others. A few experiments were made on its application as a propelling and mining agent, and the manufacture of the material upon a considerable scale was set on foot by Messrs. Hall, the well-known gunpowder-makers at Faversham, a patent having been previously taken out in this country for the production of gun-cotton according to Schönbein's process. This factory had, however, not been long in operation before a very disastrous explosion occurred at the works, by which a number of men lost their lives, and which was ascribed to the spontaneous ignition of the gun-cotton, by the jury who endeavoured to investigate its cause. From that time the manufacture of gun-cotton upon any considerable scale was abandoned in England, and no important contributions to our knowledge of this material were made until, in 1854, Hadow published the results of some valuable investigations, which served to furnish a far more definite knowledge regarding the true constitution and proper method of producing gun-cotton than had hitherto existed.

In France, gun-cotton was also made the subject of experiments as early as the winter of 1846, and its manufacture was carried on at the Government powder works at Bouchet, near Paris. Some interesting balistic experiments were instituted, under the direction of Piobert, Morin, and other men of eminence, with gun-cotton in comparison with different kinds of gunpowder, the results of which indicated that, for producing equal effects to those furnished by a given weight of gun-cotton, it was necessary to employ a double quantity of sporting powder, three times the quantity of musket powder, and four times the weight of cannon powder. It was also found that the best results appeared to be obtained by arranging the gun-cotton so that it should occupy the same space as the charge of gunpowder required to produce an equal effect; and other data were arrived at, which show that the investigators were being led to work in a direction similar to that afterwards so successfully pursued by Baron von Lenk in Austria. Unfortunately, however, disastrous explosions occurred at the works at Bouchet, one as early as March, 1847, in a drying chamber, and two, following closely upon each other, in 1848. One of these took place in a magazine near which it was believed that nobody had been for several days; the other occurred also in a magazine where gun-cotton was being packed, and on this occasion several lives were lost. These disasters appear to have put an end, until quite recently, to experiments with gun-cotton in France.

After the material had been pronounced upon unfavourably by the Committee of the German Confederation, one of its members, Baron von Lenk, continued to devote himself to its study, and with such success, it appears, that a Committee was eventually appointed by the Austrian Government in 1852 to inquire fully into the merits of the material. A sum of money was paid to Schönbein and Böttger in recognition of the value of their discovery, and an experimental manufactory of gun-cotton was established at the Castle of Hirtenberg, near Vienna. A particular form of cannon was devised by Baron von Lenk for employment with gun-cotton, of which a 12-pounder battery was established. The performances of these guns were considered sufficiently satisfactory to warrant the preparation of four more batteries, which were sent to the Army of Observation in Galicia in 1855, but did not go into active service. It appears that, in consequence of a want of uniformity in the effects of the gun-cotton, and of an injurious effect upon the guns, added probably to the prejudice entertained against it by the artillery, the material fell into disfavour, and its application in cannon was for a time abandoned. It was received, however, with much greater favour by the engineers, and was applied with great success to mining and submarine operations. Meanwhile, Baron von Lenk's labours to perfect gun-cotton as a material for artillery purposes were unceasing; and at the close of the Italian war the subject of its application was again thoroughly re-opened at the instigation of Count Degenfeld, then Minister of War, who had at an earlier period taken an active interest in Baron von Lenk's investigations. After upwards of one year's experiments, a system of rifled field and mountain-guns, to be employed with gun-cotton which had been elaborated by von Lenk, was introduced into the Austrian service. Thirty batteries of these guns were equipped, and it was considered as definitely settled that gun-cotton would before long be introduced into the service in the place of gunpowder, for artillery purposes. In 1862, however, an explosion occurred at Simmering, near Vienna, where both gunpowder and gun-cotton were stored, and this disaster appears to have fortified to such an extent the arguments which were adduced against the employment of gun-cotton by its opponents in the artillery service that its use in this direction was again put a stop to for a time. Ultimately a Committee of Investigation was appointed, which consisted in part of eminent scientific men, and which appears, after careful deliberation, to have reported highly in favour of the stability, and important properties as an explosive, of the material,—a report which was supported by the favourable opinion entertained of gun-cotton by the Austrian engineers, in whose name Baron von Ebner prepared a very complete and interesting account of the properties and effects of the agent, with particular reference to mining and other engineering operations.

Gun-cotton appears, therefore, to have been again restored to favour in Austria, but no official accounts have reached England up to the present time, with regard to its employment in the recent war operations in that country.

In the spring of 1862, full details relating to the manufacture and modes of applying gun-cotton were communicated by the Austrian Government to that of Her Majesty, and the War Office chemist was at once instructed to institute experiments upon the manufacture of gun-cotton, and upon its chemical constitution and stability. In the autumn of that year General Sabine directed the attention of the British Association to the results obtained with gun-cotton in Austria, and a combined committee of engineers and chemists was appointed to inquire into the subject. At the meeting of the Association in 1863, this committee presented a report, which was based upon information received partly from General von Lenk, who had been permitted by the Austrian Government to visit this country for the purpose of communicating fully with the British Association on the subject, and partly upon the results already arrived at in the experiments instituted by the lecturer under the direction of the Secretary of State for War. Subsequently a committee of investigation was appointed by the latter, under the presidency of General Sabine, composed of scientific men connected with the Royal Society and British Association, and of military and naval officers of considerable experience; and this committee has been entrusted with the full investigation of the properties of gun-cotton, as improved by Baron von Lenk, with reference to its applications to military, naval, engineering, and industrial purposes.

The chemical constitution of gun-cotton, concerning which the opinions of chemists were divided until 1854, has been conclusively established by the researches of Hadow. In the formation of substitution-products by the action of nitric acid upon cotton or cellulose, three atoms of the latter appear to enter together into the chemical change, and the number of atoms of hydrogen replaced by peroxide of nitrogen in the treble atom of cellulose—

$$C_{18}H_{30}O_{15}=3(C_6H_{10}O_5)$$

may be nine, eight, seven, or six, according to the degree of concentration of the nitric acid employed.

The highest of these substitution-products is tri-nitro cellulose, pyroxilin, or gun-cotton,—

$$C_{18}\left\{\begin{matrix}H_{21}\\9NO_2\end{matrix}\right\}O_{18}=3C_6\left\{\begin{matrix}H_7\\3NO\end{matrix}\right.\quad O_5;$$

this being the substance first produced by Pelouze in an impure condition, in 1838, by the action of very concentrated nitric acid upon paper, or fabrics of cotton, or linen, and afterwards obtained in a purer form by Schönbein, who employed a mixture of concentrated nitric and sulphuric acids for the treatment of cotton wool; the object of the sulphuric acid being to abstract water of hydration from the nitric acid, and also to prevent the action of the nitric acid from being interfered with by the water which is produced, as the chemical transformation of the cotton into gun-cotton proceeds. The formation of trinitro-cellulose is represented by the following equation:—

$$\underset{\text{Cotton.}}{C_6H_{10}O_5} + \underset{\text{Nitric acid.}}{3\left\{\begin{matrix}H\\NO_2\end{matrix}\right\}O} = \underset{\text{Gun-cotton.}}{C_6\left\{\begin{matrix}H_7\\3NO_2\end{matrix}\right\}O_5} + \underset{\text{Water.}}{3\left.\begin{matrix}H\\H\end{matrix}\right\}O}.$$

The lowest substitution-product from cotton, of those named above, appears to have the same composition as the substance which Braconnet first obtained in 1832, by dissolving starch in cold concentrated nitric acid, and adding water to the solution, when a white, highly combustible substance is precipitated, to which the name of *Xyloïdin* was given. The substitution-products from cotton, intermediate between the lowest and highest, are soluble in mixtures of ether and alcohol, and furnish by their solution the important material *collodion*, so invaluable in connection with photography, surgery, experimental electricity, &c.

According to Schönbein's original prescription, the cotton was to be saturated with a mixture of one part of nitric (of sp. gr. 1·5) and three parts of sulphuric acid (sp. gr. 1·85), and allowed to stand for one hour. In operating upon a small scale, the treatment of cotton with the acid for that period is quite sufficient to effect its complete conversion into the most explosive product *pyroxilin*, or *trinitrocellulose;* but when the quantity of cotton treated at one time is considerable, especially if it is not very loose and open, its complete conversion into pyroxilin is not effected with certainty unless it be allowed to remain in the acid for several hours. This accounts in great measure for the want of uniformity observed in the composition of gun-cotton and its effects as an explosive, in the earlier experiments instituted; and it is, moreover, very possible that the want of stability and, consequently, even some of the accidents which it was considered could only be ascribed to the spontaneous ignition of the material, might have been due to the comparatively unstable character of the lower products of substitution, some of which existed in the imperfectly-prepared gun-cotton.

The system of manufacture of gun-cotton elaborated by General von Lenk is founded upon that described by Schönbein; the improvements which the former has adopted all contribute importantly to the production of a thoroughly uniform and pure gun-cotton; there is only one step in his process which is certainly not essential, and about the possible utility of which chemical authorities are decidedly at variance with General von Lenk.

The following is an outline of the process of manufacture of gun-cotton as practised by Lenk. The cotton, in the form of loose yarn of different sizes, made up into hanks, is purified from certain foreign vegetable substances by treatment for a brief period with a weak solution of potashes, and subsequent washing. It is then suspended in a well-ventilated hot air chamber until all moisture has been expelled, when it is tranferred to air-tight boxes or jars, and at once removed to the dipping tank, or vessel where its saturation with the mixed acid is effected. The acids of the specific gravity prescribed by Schönbein are very intimately mixed in a suitable apparatus in the proportions originally indicated by that chemist, *i.e.*, three parts by weight of sulphuric acid to one of nitric acid. The mixture is always prepared some time before it is required, in order that it may become perfectly cool. The cotton is immersed in a bath of the mixed acids, one skein at a time, and stirred about for a few minutes, until it has become thoroughly saturated with the acids; it is then transferred to a shelf in this dipping trough, where it is allowed to drain and slightly pressed to remove any large excess of acid, and is afterwards placed in an earthenware jar provided with a tightly-fitting lid, which receives six or eight skeins, weighing from two to four ounces each. The cotton is tightly pressed down in the jar, and if there be not sufficient acid present just to cover the mass, a little more is added: the proportion of acid to be left in contact with the cotton being about ten and a-half pounds to one pound of the latter. The charged jars are set aside for forty-eight hours in a cool place, where, moreover, they are kept surrounded by water to prevent the occurrence of any elevation of temperature and consequent destructive action of the acids upon the gun-cotton. The same precaution is also taken with the dipping-trough, as considerable heat is generated during the first saturation of the cotton with the acids. At the expiration of forty-eight hours the gun-cotton is transferred from the jars to a centrifugal machine, by the aid of which the excess of acid is removed as perfectly as is possible by mechanical means, the gun-cotton being afterwards only slightly moist to the touch. The skeins are then immersed singly into water, and moved about briskly, so as to become completely saturated with it as quickly as possible. This result is best accomplished by plunging the skeins under a fall of water, so that they become at once thoroughly drenched. If they are simply thrown into water and allowed to remain at rest, the heat produced by the union of a portion of the free acids, with a little water would be so great as to establish at once a destructive action upon the gun-cotton by the acid present. The washing of the separate skeins is continued until no acidity can be detected in them by the taste; they are then arranged in frames or crates and immersed in a rapid stream of water, where they remain undisturbed for two or three weeks. They are afterwards washed by hand to free them from mechanical impurities derived from the stream, and are immersed for a short time in a dilute boiling solution of potashes. After this treatment, they are returned to the stream, where they again remain for several days. Upon their removal they are once more washed by hand, with soap if necessary; the pure gun-cotton then only requires drying by sufficient exposure to air at a temperature of about 27° C. to render it ready for use. A supplementary process is, however, adopted by General von Lauk, about the possible advantage or use of which his opinion is not shared by others, as already stated. This treatment consists in immersing the air-dried gun-cotton in a moderately strong, hot solution of soluble glass (silicate of potassa or soda) for a sufficient period to allow it to become completely impregnated, removing the excess of liquid by means of the centrifugal machine; thoroughly drying the gun-cotton thus "silicated," and finally washing it once more for some time until all alkali is abstracted. Lenk considers that by this treatment some silica becomes deposited within the fibres of the gun-cotton, which, on the one hand, assists in moderating the rapidity with which the material burns; and, on the other hand, exercises (in some not very evident manner) a preservative effect upon the gun-cotton, rendering it less prone to undergo even slight changes by keeping. The mineral matter contained in pure gun-cotton which has not been submitted to this particular treatment amounts to about 1 per cent. The proportions found in specimens which have been "silicated" in Austria and in this country, according to Lenk's directions, varies between 1·5 and 2 per cent. It is difficult to understand how the addition of 1 per cent. to the mineral matter, in the form chiefly of silicate of lime and magnèsia (the bases being derived from the water used in the final washing) which are deposited upon and between the fibres in a pulverulent form, can influence to any material extent either the rate of combustion or the keeping qualities of the product obtained by Leuk's system of manufacture.

Gun-cotton, prepared according to the system just described, is exceedingly uniform in composition. The analyses of samples prepared both in Austria and at Waltham Abbey have furnished results corresponding accurately to those required by the formula—

$$C_6\left\{\begin{matrix}H\\3NO_2\end{matrix}\right\}O_5.$$

In its ordinary air-dry condition, it contains, very uniformly, about 2 per cent. of moisture—an amount which it absorbs again rapidly from the air when it has been dried. The proportion of water existing in the purified air-dried cotton, before conversion, is generally about 6 per cent. When pure gun-cotton is exposed to a very moist atmosphere or kept in a damp locality, it will absorb as much as from 6 to 7 per cent.; but if it be then exposed to air of average dryness, it very speedily parts with all but the 2 per cent. of moisture which it contains in its normal condition. It may be preserved in a damp or wet state apparently for an indefinite period without injury; for if afterwards dried by exposure to air, it exhibits no signs of change.

In these respects it possesses important advantages over gunpowder. The normal proportion of hygroscopic moisture in that substance varies three-quarters and one per cent.; but if exposed in any way to the influence of a moist atmosphere, it continues to absorb water until, however firm the grains may have originally been, it becomes quite pasty. It need scarcely be stated that when once gunpowder has become damp, it can no longer be restored to a serviceable condition, except by being again submitted to the processes of manufacture, starting almost from the commencement.

Perhaps the most vital considerations bearing upon the possibility of applying gun-cotton to important practical purposes, are those which relate to the risk likely to be incurred in its manufacture and preservation, in large quantities. The manufacture of gun-cotton is, unquestionably, much safer than that of gunpowder; in fact, there is no possibility of accident until the final drying process is reached, as, in all the other stages, the material is always wet, and therefore harmless. With the adoption of a proper system of warming and ventilation in the drying-chamber, the last operation is certainly not a more dangerous one than that of gunpowder. The question of the safe preservation of gun-cotton cannot, as yet, be so easily and satisfactorily disposed of. Specimens of gun-cotton exist which were prepared according to Schönbein's directions in 1846, and which have undergone no change whatever; on the other hand, it is well known that gun-cotton which was believed to have been perfectly purified, has become extremely acid, and has even undergone so complete a decomposition as to have become converted into oxalic acid and other organic products, when preserved in closed vessels, and especially when exposed continuously or occasionally to light. This susceptibility to chemical change has been particularly observed in samples of gun-cotton known to consist chiefly, or to contain some proportion, of the less explosive or lower substitution products (*i.e.*, gun-cotton specially prepared for the manufacture of collodion). Hence it is very possible that such instances as are considered to have been well authenticated, of the spontaneous ignition of gun-cotton when stored in considerable quantities, or during exposure to very moderate heat, may have arisen, not simply from an imperfect purification of the material, but also from the more or less imperfect conversion of cotton into the most explosive and apparently most stable product.

There is no doubt that the improvements effected in the system of manufacture of gun-cotton have been instrumental in rendering it far more stable in character than it was in the early days of its production upon a considerable scale. At the same time, although General von Lenk and its warmest partisans consider that its unchangeability can no longer be disputed, a greater amount of experience, combined with more searching investigations than have hitherto been instituted, upon the possibility of its undergoing change when under the influence of moderate heat, alone or combined with that of moisture, or when preserved under a variety of conditions, are unquestionably indispensable before its claims to perfect permanence can be considered as properly established. It has already been ascertained, by very recent experiments of the lecturer, that gun-cotton prepared and purified with the most scrupulous care speedily undergoes some amount of decomposition when exposed to temperatures ranging from 32° to 66° C.; it remains to be seen whether such decomposition, if once established by exposure of gun-cotton to some temperature within the above limit, will cease permanently when the material is removed from the influence of heat, or whether precautions or efficient supplementary processes can be adopted in the manufacture, to counteract the tendency to change exhibited by gun-cotton under the above circumstances. These are only some of the points which need patient investigation before it is positively known whether the requisite confidence can be placed in the material, as an agent susceptible of substitution for gunpowder.

It has been ingeniously argued that a slight indication of spontaneous change in gun-cotton need give rise to no alarm, because gunpowder is also liable to slight spontaneous change, reference being made to the fact that a very minute proportion of the sulphur in that material has been noticed to undergo oxidation. It need hardly be stated that such a minute change cannot have the slightest effect upon the stability of the mechanical mixture gunpowder, in which variations as regards purity and proportions of ingredients occur to an extent which render this change of absolute insignificance; whereas, in the case of gun-cotton, as now manufactured, the development of acid, however minute the proportion, may very possibly give rise to an important disturbance of chemical equilibrium in a compound, the stability of which is based upon the perfect uniformity of its composition; and it may also be at once productive of further change by the tendency which the acid itself has to exert chemical action upon certain elements of the gun-cotton.

The general properties of gun-cotton as an explosive agent have long been popularly known to be as follows:—When inflamed or raised to a temperature ranging between 137° and 150° C. it burns with a bright flash and large body of flame, unaccompanied by smoke, and leaves no appreciable residue. It is far more readily inflamed by powerful percussion than gunpowder; the compression of any particular portion of a mass of loose gun-cotton between rigid surfaces will prevent that part from burning when heat is applied. The products of combustion of gun-cotton in air redden litmus paper powerfully; they contain a considerable proportion of nitric oxide, and act rapidly and corrosively upon iron and gun-metal. The explosion of gun-cotton when in the loose, carded condition—the form in which it was always prepared in the early days of its discovery—resembles that of the fulminates in its violence and instantaneous character. In the open air it may be inflamed when in actual contact with gunpowder without igniting the latter; in a confined space, as in a shell or the barrel of a gun, the almost instantaneous rapidity of its explosion produces effects which are highly destructive as compared with those of gunpowder, while the projectile force exerted by it is comparatively small.

Professor of Chemistry to the Royal Academy.—The members of the Academy appointed to consider the Report of the Royal Commissioners have joined in the recommendation of a professorship of "chemistry as applicable to art." We have already advocated the appointment as most desirable, and hope the Academicians will soon give effect to the recommendation.

CHEMICAL SOCIETY.

Thursday, May 5, 1864.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

The minutes of the previous ordinary meeting having been read and confirmed, the following gentlemen were balloted for and duly elected Fellows of the Society—viz., Mr. T. S. Conysbee, engineer; Mr. Edward H. Prentice; M. Carl Schorlemmer, Owen's College, Manchester; and Mr. Edward F. Teschèmacher, Highbury Park.

The President then invited Sir Benjamin Brodie to favour the Society with a discourse entitled *"On the Organic Peroxides Theoretically Considered."* The lecturer then gave a most interesting and detailed account of his experiments upon the action of peroxide of barium upon the organic acids, and proceeded to enunciate the basis of his theoretical views regarding the constitution of these bodies. Numerous tables of formulæ were referred to in the course of the lecture, and many beautiful specimens of the chemical products in question were exhibited.

The author commenced by giving an historical sketch of the hypotheses of Dalton, Gerhardt, and several intermediate schemes which have from time to time prevailed. Most or all of these assume that the molecule of oxygen in water stands related to the hydrogen exactly in a similar manner as does chlorine to hydrogen in hydrochloric acid, and, consequently, that oxygen is the analogue of chlorine. The lecturer believed, however, that he should be able to demonstrate the error of this opinion, and was prepared to bring forward evidence to prove that peroxide of hydrogen, not oxygen, was the analogue of chlorine. Thus—

$$2HCl = H_2 + Cl_2,$$

and—

$$2H_2O = H_2 + H_2O_2.$$

In viewing the constitution of bodies framed on the ammonia type, it would be found that amidogen, H_2N, stands for chlorine; and in proceeding to classify the elements, it was known that chlorine, bromine, and iodine were alike, but that oxygen and sulphur constituted another group, and phosphorus and nitrogen a third. The new organic peroxides would, however, arrange themselves beside chlorine, &c., and exhibit many properties common to the elements of that group; for instance, they possessed powerful bleaching properties; were decomposed by light with evolution of oxygen gas; and their solutions immediately peroxidised the proto-salts of iron and manganese.

The preparation of the all-important agent—the peroxide of barium, Ba_2O_2—was then briefly described. By taking the ordinary crude product resulting from the passage of oxygen gas over heated baryta, a pure substance could be obtained by dissolving in cold dilute hydrochloric acid, and then adding to the solution baryta water until the precipitation was complete. The hydrated peroxide was thus thrown down in the form of lustrous crystalline plates, which should be well washed and dried. By the loss of water, the substance fell to a white powder, somewhat like magnesia in appearance; and in this form it was sometimes employed. The action of peroxide of barium upon anhydrous benzoic, succinic, lactic, and camphoric acids had been ascertained: all these gave rise to the production of organic peroxides, some of which had been already analysed. Glacial acetic acid, mixed with dry ether, furnished the peroxide of acetyl, which exhibited powerfully explosive properties.

In the preparation of peroxide of benzoyl, $C_{14}H_{10}O_4$, the anhydrous benzoic acid or the chloride of benzoyl might be employed. Equivalent proportions of the peroxide of barium, and either of these compounds, were rubbed together in a mortar, allowed to remain for some time in contact, then thrown upon a filter, and the chloride of barium, or other soluble salts, removed by washing with water. The product, after drying, could be crystallised by dissolving in bisulphide of carbon; and by the evaporation of this solvent the peroxide of benzoyl was obtained in beautiful large white crystals like sugar candy. It was necessary to attend strictly to the proportions; for if more than the prescribed amount of peroxide of barium be employed the yield is less, or the product is altogether decomposed, according to a secondary reaction, which was thus expressed:—

$$Bz_2O_2 + Ba_2O_2 = 2BaBzO + O_2.$$

No oxygen was evolved, nor benzoate of barium formed when the substances were carefully mixed in the ratio required by the formula—

$$2BzCl + Ba_2O_2 = 2BaCl + Bz_2O_2.$$

This peroxide is but slightly explosive as compared with the corresponding compound of acetyl. When boiled with solution of caustic potassa, oxygen gas was evolved, and an alkaline benzoate formed—

$$Bz_2O_2 + 2KHO = 2KBzO + O + H_2O.$$

The evolution of oxygen gas during the decomposition of an organic substance was alluded to as being a very unusual phenomenon.

By corresponding treatment of acetic acid with peroxide of barium a similar compound was formed. The author employed a mixture of glacial acetic acid and anhydrous ether, and digested for an hour or two with an equivalent proportion of the peroxide of barium gradually added, the temperature being kept low. At the end of this time it was filtered, and an etherial solution of the peroxide of acetyl passed through, which, on evaporation, furnished a viscid liquid capable of being crystallised by artificial cold. Some experiments with the etherial solution were then shown, and many of its leading properties thus demonstrated, particularly its power of bleaching indigo solution, of peroxidising the recently precipitated protoxide of manganese, and of liberating iodine from iodic acid. The action of light upon the peroxide of acetyl was ramarkable, and so far as these experiments had proceeded, it appeared that the substance could be preserved without diminution of bulk in an open glass tube shielded from the light, but when exposed freely to sunshine the substance was decomposed, with liberation of oxygen gas, and returned to acetic acid, which then gradually evaporated. Here, again, might be traced a parallel between the results of the action of light upon the organic peroxides and the aqueous solution of chlorine. Potassa behaved also in a similar manner, oxygen being eliminated, and a salt of the alkali formed. The violently explosive character of the peroxide of acetyl rendered it necessary to exercise the greatest caution in its preparation. It was whilst being engaged in the production of a small quantity of the pure substance for analysis that Professor Brodie met with the accident which prevented his attending the meeting of the Society originally appointed for the delivery of this lecture. He had obtained about thirty drops of the peroxide of acetyl by the distillation of a quantity of the etherial solution, and was proceeding to dry the same by the gradual addition of fused chloride of calcium, when, upon dropping into the retort the eighth or tenth piece, the whole of the product suddenly exploded, and, of course, shattered the glass apparatus in which it was contained. The same property in a minor degree was exhibited by the peroxide of benzoyl; a small quantity of this substance was then heated in a test tube, when it detonated slightly. Under these circumstances, the lecturer found that about half the constituent carbon escaped as carbonic anhydride, the rest being occupied in the formation of two or three resinous bodies, which had not yet been examined.

The second division of the subject comprehended an account of the peroxides of radicals of the diatomic acids. Under this head much less was known, but the author had prepared the peroxides corresponding to succinic, camphoric, and lactic acids, of which he had partially made the analyses, and ascertained that their general properties were bleaching and oxidising. From anhydrous camphoric acid, $C_{10}H_{14}O_3$, the author had succeeded in preparing the barium salt of an anhydrous bibasic radical. Its formula was $C_{10}H_{14}O_3Ba_2$.

Succinic acid gave a similar barium compound, which was soluble in water, and when the solution was heated it gave off oxygen, and furnished a white precipitate of the ordinary succinate of barium. The peroxide of succinyl was so rapidly changed that it had not yet been obtained in a pure state. Bodies of this class were distinguished by their power of effecting the peroxidation of the hydrated protoxide of manganese, but they did not evolve oxygen from chromic and manganic acids. It would be evident from the foregoing statement that the organic peroxides would arrange themselves into two groups, viz., the monatomic and the diatomic analogues of chlorine. This difference might be symbolised by the equations—

$$1.\ C_2H_6 + Cl_2 = 2CH_3Cl.$$
$$2.\ C_2H_4 + Cl_2 = C_2H_4Cl_2.$$

From the preceding investigation the author considered himself justified in announcing the existence of a group of chemical substances, which comport themselves exactly like chlorine, and are constituted of organic radicals in association with a maximum of oxygen. These facts lent support to the binary theory of salts as originally proposed by Dulong, and established by the later experiments of Daniell and Miller; and, taken in conjunction with the theory of radicals as advocated by Laurent and Gerhardt, Williamson, Kekulé, and others, offered a complete and satisfactory explanation of many hitherto doubtful chemical reactions. Reference was made, in conclusion, to the disappearance of oxygen at the positive pole during the electrolysis of water and of dilute sulphuric acid. Maidinger had shown that when sulphuric acid of the gravity 1·3 was decomposed by the battery a very notable diminution in the proportion of oxygen was observed, and that the liquid acquired the property of separating iodine from hydriodic acid. He had attributed this result to the production in the liquid of the peroxide of hydrogen, but the lecturer considered it more probable from the chromic acid reaction that a sulphur acid higher in the series than sulphuric acid was generated, and that the formation of persulphuric acid, H_2SO_5, would hereafter be substantiated. It was, however, necessary to admit at once the policy of framing a new group of radicals, which, although compound, were to be treated of exactly in the same manner as chlorine. This analogy to chlorine suggested many promising lines of research; thus, Are the organic peroxides capable of uniting with olefiant gas and with carbonic oxide? And will it be possible to form substitution compounds in which these new bodies will replace hydrogen?

The President rose to offer in the name of the Society a vote of thanks to Professor Brodie for the masterly discourse with which he had favoured them. The interest which attaches to the substances described, which are both compounds of radicals and radicals in themselves, is such that the whole subject deserves to be written in golden letters in the annals of the Society. He wished to ask the lecturer whether he found it possible to "lock up" two molecules into one compound radical?

Professor A. W. Hofmann had listened with great pleasure not only to that portion of the discourse which treated of a rich variety of chemical reactions, but particularly to the lecturer's remarks wherein he sketched out the future of his discoveries. For his own part, he was anxious to hear some account of the parallelism between chlorine and the organic peroxides with regard to their action on ammonia.

Professor Wanklyn referred to the artificial production of glycol by the direct action of peroxide of hydrogen upon ethylene, as announced by Carius, as having already realised one of the speculations entertained by the lecturer.

Mr. Smee and Sir Robert Kane offered some remarks in confirmation of the binary theory of salts, and the support to be gathered from the law of electrolysis, certain technical points in the voltaic deposition of copper being likewise referred to.

Dr. W. A. Miller considered that the simple view of electrolytic decomposition which was sometimes advocated was untrue in a great number of instances. There were often several products—not two only—formed simultaneously, and the results were then more complicated than had been represented.

Sir Benjamin Brodie, in reply, stated that he had endeavoured to prepare organic peroxides containing two radicals or molecules—thus benzoyl and acetyl had been tried in admixture—but he had not yet succeeded in associating them or any other members of distinct series. Respecting the production of glycol through the intervention of peroxide of hydrogen, he did not consider that there were sufficient grounds for believing that this had really been accomplished. The experiments alluded to by Professor Wanklyn did not appear to be sufficiently specific. The term "peroxide of hydrogen" was always applied to a solution of that substance in water, but he hoped the day was not far distant when the pure peroxide, H_2O_2, would be isolated. The action of ammonia upon peroxide of benzoyl had been partially investigated. The products were benzoic acid, benzamide, and nitrogen, but there appeared to be other bodies formed which could not yet be defined.

The meeting was then adjourned by the President until the 19th instant, and the titles of several papers were announced.

Thursday, May 19, 1864.

The minutes of the previous meeting having been read and confirmed,

The President announced that steps had been taken by the Council for the purpose of aiding the subscription towards the erection of a memorial to Sir Humphry Davy in Penzance. It had been resolved to appoint Mr. West collector, and any funds placed in his hands would be in due course forwarded in the name of the Society to the Cornwall Committee.

Mr. Conysbee was formally admitted a Fellow of the Society; and Dr. Wrightson, of Birmingham, and Mr. Manning Prentice, of University College, London, were duly elected by ballot.

The President had much pleasure in announcing that among the visitors with whom they were favoured on the present occasion was Dr. De Vrij, who had lately returned from Java.

A paper "*On the Constitution of Wood Spirit*," by Mr. William Dancer, of Manchester, Dalton Scholar, was read by the Secretary. The author had, upon the recommendation of Professor Roscoe, undertaken the chemical examination of crude wood spirit, and had been led by his experiments to the conclusion that four different substances in admixture made up the bulk of the rough commercial product. The separation of these was conducted in the following manner:—The crude spirit was treated with chloride of calcium and submitted to fractional distillation, or a larger quantity of the wood spirit was dried over quick-lime, and then distilled from hydrate of soda, whereby the acetate of methyl was decomposed. The acetone was then separated by digesting with bisulphide of soda, and the residual liquor distilled from fused potassa. After employing chloride of calcium to unite with the methylic alcohol, a liquid passed over between the temperatures of 55° and 70° C, upon which sodium had no action. This product was found to be bimethyl-acetal, having the boiling point 63-64° C, and vapour density equal to 3·165; calculation demanding the number 3·114. Its specific gravity at zero Centigrade was 0·8787, as compared with water at its maximum density, viz., at 4° C. All its properties agreed with those described by

Wurtz as appertaining to the product of the action of binoxide of manganese and sulphuric acid upon a mixture of ethylic and methylic alcohols. The quantity of bimethyl-acetal found in two litres of ordinary wood spirit varied in different samples from 10 to 20 grammes. The author concluded by summing up the constituents of crude wood naphtha, and stated that besides the great bulk of methylic alcohol there were present acetate of methyl, acetone, and bimethyl-acetal, but he ignored altogether the existence in this product of the substance hitherto described under the name of xylyl.

The next communication, by Dr. J. H. Gladstone and Mr. Holmes, "*On the Chloro-phosphide of Nitrogen, and on two new Acids related thereto*," was read by Dr. Odling. The authors refer to a previous publication on the same subject by Dr. Gladstone alone in the third volume of the Society's *Quarterly Journal*, wherein it was stated that the chloro-phosphide had the formula $P_3N_2Cl_5$. Laurent, in 1850, questioned the accuracy of this expression from considerations of a theoretical nature, and the authors were now prepared to admit as the correct formula that proposed by the eminent French chemist, viz.:—$P_3N_3Cl_6$. This substance was produced by the action of ammonia upon pentachloride of phosphorus, but the simplest expression in the form of an equation did not by any means represent the changes actually occurring. The two acids were named respectively azo-phosphoric and deutazo-phosphoric, and one of the most striking peculiarities of the latter was that the ferric salt was soluble in ammonia. Deutazo-phosphoric acid was produced by the action of dry ammonia gas on the oxychloride of phosphorus (Wurtz), and was soluble in water, and from the copper or iron salt by the effect of heat the azo-phosphoric acid was formed. The deutazo-phosphate of iron $Fe_2P_2NH_4O_7$, was very soluble and hygroscopic, and the zinc, copper, and barium salts had been prepared and examined. The analysis of the azophosphate of silver led to the formula—$Ag_2P_2N_2H_4O_8$. The names "pyrophosphamic acid" and "pyrophosphordiamic acid" had been proposed for these compounds, but were not generally adopted.

The PRESIDENT considered there was no reason to hesitate in writing the equation explanatory of the production of the chlorophosphide of nitrogen as follows:—

$$3NH_3 + 3PCl_5 = 9HCl + P_3N_3Cl_6.$$

Mr. HOLMES stated that the amount of the product was so small that this equation could not truly express the change; there appeared to be secondary products which engaged some of the phosphorus.

At this stage of the proceedings the President vacated the chair, which was then occupied during the remainder of a long evening by Mr. Warington, and the following papers were read, viz.:—"*On a New Method of Gas Analysis*," by the PRESIDENT and Dr. RUSSELL; and the PRESIDENT afterwards favoured the Society with some remarks "*On the Classification of the Elements according to their Atomic Weights.*" An abstract of these communications must, from want of space, be deferred until next week.

ACADEMY OF SCIENCES.

May 16.

M. BOUSSINGAULT communicated the first part of a memoir "*On Vegetation in Darkness.*" The author brings forward several experiments which prove that the growth of a plant in the dark is supported entirely at the expense of the seed. We give the results of one experiment, made with grains of wheat or maize sown in moistened sand, and kept quite in the dark:—

Weight of seed . .	. 0·926	milligrammes.
Weight of plant grown	. 0·566	"
Loss of weight .	. 0·360	"

Another grain was sown in the same soil, but exposed to light. In this instance the results were as follows:—

Weight of seed . .	. 0·922	milligrammes.
Weight of plant .	. 0·293	"
Gain of weight .	. 0·371	"

It is interesting also to compare the gain or loss of carbon, oxygen, and hydrogen in these two cases:—

	In the light.		In the dark.
Carbon acquired .	. 0·1926	lost	0·1598
Hydrogen acquired .	. 0·0200	"	0·0232
Oxygen acquired .	. 0·1591	"	0·1766

Thus it is seen that under the influence of air and moisture, in a soil deprived of manure, a plant in the light assimilates carbon, and, at the same time, fixes hydrogen and oxygen in the proportions to form water. In the dark, on the contrary, carbon is eliminated, and so are hydrogen and oxygen also in the proportions to form water.

A note, by M. Lemoine, "*On the Action of Red Phosphorus on Sulphur*," gives an account of some compounds of the two elements. The author found that when these two bodies reacted on each other they produced a compound having the formula P_4S_3. This compound is invariably produced, whatever the proportions employed may be. It is a very stable body, not oxidising in the air, which crystallises in the right rhombic prismatic system, boils and distils between 300° and 400° C., and dissolves in sulphide of carbon and chloride of phosphorus, from which latter solution water separates it unaltered. Alcohol and ether dissolve, but, at the same time, decompose it. It is perfectly soluble in the sulphides of potassium and sodium. Caustic potash dissolves it even in the cold, disengaging a mixture of hydrogen and phosphuretted hydrogen. Assisted by heat, the reaction produces sulphide of potassium and phosphite of potash. We ought to say that the author produced the compound by heating the two constituents together, and then separated it by means of sulphide of carbon, in which, as we have said, it easily dissolves.

M. Wurtz contributed the second part of an elaborate paper "*On the Diallylic Compounds.*" The author states, as the results of his researches, that there exist two series of diallylic compounds. The radical diallyl may combine with one or with two molecules of hydriodic acid, and form also corresponding acetates and hydrates. The two series are double, and just as the compounds of the diatomic series of diallyl are isomeric with the hexylic compounds, so, in the mono-atomic series, there appears to exist two isomeric hydrates.

M. Hardy presented a note "*On the Decomposition of Uric Acid by Bromine, and the Action of Heat on Alloxan.*" Bromine gives no substitution products with uric acid, but in the presence of water splits it up into alloxan and urea, forming, at the same time, hydrobromic acid. If the temperature be high, more complex changes take place, and parabanic and oxalic acids are formed, with some hydrobromate of ammonia. Chlorine and iodine give results similar to those with bromine. Alloxan heated to 150° loses two atoms of water; if the heat be carried to 250° it loses no more water, but acquires the property of giving coloured solutions. When treated with a base this modified alloxan fixes two atoms of water, and forms an acid identical in composition with alloxanic acid, but which gives coloured salts. The author proposes to call this *Isoalloxanic Acid*. The author believes that the purple compound produced in the well-known nitric acid and ammonia test for uric acid is not murexide, but isoalloxanate of ammonia.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following paper will be read:—"Discrimination of Organic Bodies by their Optical Properties," by Prof. Stokes.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

937. Thomas Steven, Glasgow, and Charles Batty, London, "Improvements in arrangements and apparatus for ventilating, for protecting from heat, and for heating and cooking."—Petition recorded April 14, 1864.

993. D'Herman Lomer, Brussels, Belgium, "Obtaining colouring matter as substitute for aniline colours."—Petition recorded April 21, 1864.

1071. George Schaub, New Hanley Road West, Upper Holloway, Middlesex, "An improved mode of transmitting currents of electricity for telegraphic purposes."

1072. Thomas Goulston Ghislin, Hatton Garden, London, "Improvements in the treatment and application of sea-weed."—Petitions recorded April 28, 1864.

1073. Marc Antoine François Menoons, Westminster, "An improved apparatus for the capsulation of fluid medicines."—A communication from Jules Viel, Tours, France.

1076. Richard Hudson Smithett, Inner Temple, and John Davidson, Temple Street, Blackfriars, "Improvements in treating clay, artificial stone, metal, or other plastic or malleable material, to render it more suitable for constructive purposes."

1077. John Davidson, Temple Street, Blackfriars, "Improvements in the manufacture of bricks or blocks for use in the formation of arches from clay, artificial stone, or other similar plastic materials, and in the apparatus used in such manufacture."

1081. Richard Archibald Brooman, Fleet Street, London, "A new method of treating wood and other ligneous substances in order to produce alcohol and to obtain the cellular tissue or fibre from such substances applicable to the manufacture of paper and other uses."—A communication from François Marie Bachet and Etienne Machard, Annecy, France.

1082. John M'Call, Houndsditch, London, and Bevan George Sloper, Walthamstow, Essex, "Improvements in preparing and preserving food."

1087. Frank Clarke Hills, Deptford, Kent, "Improvements in and applicable to furnaces to be used in the manufacture of gas."

1088. Frank Clarke Hills, Deptford, Kent, "Improvements in the purification of gas, and in obtaining a valuable product in the process, and for the preparation of some of the materials to be used in the said purification."—Petitions recorded April 29, 1864.

1095. Richard Archibald Brooman, Fleet Street, London, "Improvements in tanning." A communication from Barthelemy Picard, Puteaux, France.

1100. James Lee Norton, Balla Sauvage Yard, Ludgate Hill, London, Francis Gregory and James Salmon, Manchester, Lancashire, "Improvements in presses and apparatus connected therewith, and in pressing fats, seeds, shoddy, cotton waste, tobacco, and paper."—Petitions recorded April 30, 1864.

1107. Peter Armand Lecomte de Fontainemoreau, Rue de la Fidélité, Paris, France, "Certain improvements in apparatus for washing ores and other substances, and in separating earth and other impurities adhering to them." A communication from Jean Emile Austruy, Paris, France. —Petition recorded May 2, 1864.

1111. Alfred Watson Glitens, Hull, Yorkshire, "An improved method of finishing photographic pictures and marbled papers, and improvements in pressing rolls employed therein, and applicable to other pressing rolls."

118. William Smith, Lower Bagot Street, Dublin, "Improvements in the manufacture of artificial fuel."—Petitions recorded May 3, 1864.

1119. Edward Beanes, Argyll Street, London, "Improvements in the treating of animal charcoal."

1121. Benjamin Hammerton, Bolton, Lancashire, "Improvements in miners' safety lamps."

1123. William M'Vitie, Glasgow, N.B., "Improved arrangements for inducing the circulation of a liquid for condensing or refrigerating."

1125. Thomas Henry Rees, Dennett Road, Hatcham, Surrey, "Improvements in blue colouring matters for washing purposes, and in receptacles for containing the same ready for use."

1128. John Thompson, Hilldrop Crescent, Camden Road, "Improvements in apparatus for securing stoppers for bottles."—Petitions recorded May 4, 1864.

1161. Alfred Vincent Newton, Chancery Lane, Middlesex, "Improved apparatus for facilitating the inhalation of medicinal substances."—A communication from John Jones, New York, U.S.—Petition recorded May 7, 1864.

1173. Francis Herbert Wenham, Union Road, Clapham, Surrey, "Improvements in motive power engines worked by explosive mixtures of gas or vapour."—Petition recorded May 9, 1864.

1187. Nathan Thompson, Abbey Gardens, St. John's Wood, Middlesex, "Improvements in apparatus for stopping bottles, jars, and other vessels."—Petition recorded May 10, 1864.

Notices to Proceed.

30. Joseph Judge Haye, Hitchin, Hertford, "Improvements in the manufacture of peat charcoal, and in the apparatus employed therein."—Petition recorded January 5, 1864.

101. William Jeremiah Murphy, Cork, Ireland, "An improved steam-brewing copper."

106. Nathan Thompson, Abbey Gardens, St. John's Wood, Middlesex, "Improvements in apparatus for stopping bottles, jars, and other vessels, which improvements are also applicable to stopping the muzzles of firearms."—Petitions recorded January 14, 1864.

109. John Edward Baker, Birmingham, Warwick, "Improvements in retorts and furnaces for distilling coal and peat, and other solid hydrocarbons, for the manufacture of volatile oils therefrom, which improvements may also be applied to retorts and furnaces used for other purposes."—Petition recorded January 15, 1864.

195. Robert Alfred Wright, Pentonville Road, Middlesex, and Ernest Wright, Nelson Square, Surrey, "Improvements in apparatus for consuming smoke and promoting the combustion of fuel in furnaces."—Petition recorded January 23, 1864.

332. James Webster, Lee Crescent, Birmingham, Warwick, "Improvements in the preparation of paints or varnishes."—Petition recorded February 8, 1864.

335. John Clutton Blair Salt, Birmingham, Warwick, "Improvements in protecting iron ships and vessels from corrosion."—Petition recorded February 9, 1864.

436. William Charles Page, Millwall, Poplar, Middlesex, "An improved composition for coating ships' bottoms."—Petition recorded February 19, 1864.

952. Charles Doughty and William Drake Key, Lincoln, "Improvements in treating a product obtained in refining the oil of cotton seeds."—Petitions recorded April 15, 1864.

Honorary Degrees at Cambridge.—Of all the honorary degrees to be conferred at the approaching Royal visit to the University of Cambridge, none, it must be confessed, will be more worthily bestowed than those on Dr. Hofmann and Professor Wheatstone.

Royal Institution.—Tuesday, May 31, at three o'clock. Professor Marshall, "On Animal Life." Thursday, June 2, at three o'clock, J. Hullah, Esq., "On Music (1600—1750)." Friday, June 3, at eight o'clock, Professor Frankland. Saturday, June 4, at three o'clock, Alexander S. Herschel, Esq., "On Falling Stars."

CORRESPONDENCE.

Hicks' Standard Barometer.

To the Editor of the Chemical News.

Sir,—It is no doubt generally believed that papers received and published by the Royal Society are subjected to a more rigid scrutiny than is usually adopted in the other so-called learned societies. Although probably the responsibility is supposed to rest with the author of the paper, yet still by this supposed greater care in accepting papers the Royal Society assumes a greater amount of this responsibility, and at least gives the sanction of its authority to the paper as a new and, more or less, a valuable contribution to science. In the proceedings for this year, page 169, is published a description of a standard barometer, which, from the way it is introduced, would be accepted by the readers as quite new and original. In connection with this subject, I beg leave to draw your attention to the following quotation—not from some obscure contribution to science buried under the great accumulation of learned and unlearned lore which the press is continually pouring forth in such an abundance that the admirable Crichton himself would be baffled in attempting to master it all, but from a work supposed to be in every scientific library—the *Encyclopædia Brittanica*, seventh edition, 1842, vol. iv., page 391, and again appearing, probably from the same stereotype plates, in the eighth edition: the writer is Sir J. Leslie:—

"The most accurate construction of a barometer of this kind [the conical barometer invented by Amontous in 1695] is attained by joining two tubes that have even, but unequal, bores, the longer and narrower being uppermost. If the width of the upper tube were supposed to be to that of the under one as two to three, the scale would be enlarged three times, since by descending three inches from the top, and consequently two at the bottom, the column would suffer a contraction of one inch in height. This species of barometer is thus recommended by its simplicity and its ample range. But the bore of the tube being indispensably small, the mercury moves with difficulty, and resists the impression of minute changes of external action."

I could mention the names of persons in London and elsewhere who have made such instruments long since; but the defect here alluded to has no doubt prevented any very general adoption of this form of barometer; and it can only be removed by Whiting's plan, as shown by Mr. Becker in the *soirée* of the Royal Society last year—viz., by using a larger tube and a moveable piston at the bottom. But there appear to be practical difficulties attending this form also. Mr. Becker told me, and no doubt others, that Whiting had also constructed instruments as above described. Most persons familiar with the instrument will, I think, from the defect alluded to by Sir J. Leslie, still doubt the applicability of this form of instrument as a standard barometer, at least until proved by actual work. But the following extract from the same work (page 400) and by the same author will show that the plan of adapting a scale of inches to it is more than twenty years old:—

"A modification of the conical barometer, in travelling, we have ourselves employed. The principal part consists of a small steel stop-cock; a glass tube, 31 or 32 inches long, with a bore of the tenth of an inch, sealed at the top and filled with quicksilver, is cemented into one end of the stop-cock, and into the other end is cemented an open and wider tube, 16 inches or more in length, and having its diameter above the eighth of an inch. This compound tube is lodged in a walking stick divided into inches and tenths through its whole extent, or only at the upper part."

It is true there is no mention of verniers here, but seeing that scarcely any barometer sold is without verniers, the addition of these seems hardly sufficient to warrant recording their adoption as among the scientific discoveries and inventions of the year. It may be confidently asserted that if any competent maker received an order for a barometer to be made from Sir J. Leslie's description, he would have made it with verniers, and most probably have divided it exactly as the instrument described in the *Proceedings* of the Royal Society, without thinking for a moment that he was making a new instrument.

It may be considered quite allowable in the way of trade for a maker to introduce an instrument little known, and if the trade accept it as such, to sell it with his own name attached to it, and it would be very foolish for him not to avail himself of any honourable and straightforward means of introducing his instruments and his name to public notice, but it was hardly to be anticipated that the Royal Society would stamp with its authority claims which can thus be so completely set aside by extracts from so popular a work; and as no doubt the *Proceedings* of the Royal Society would be generally considered authoritative in matters connected with the history of science, perhaps you will consider these observations worth recording in your columns. It may be mentioned that this barometer as first described without the scale of inches appears in the "*Journal of the Society of Arts*" for the 1st of April l as a newly-invented instrument.

I am, &c. W. Symons.

17, St. Mark's Crescent, Regent's Park, May 19.

MISCELLANEOUS.

YOUNG *v.* FERNIE.

(*Continued from page 252.*)

Dr. Hofmann's evidence continued: I have read the extracts from the works of Morand. ["The Art of Working Coal Mines." By M. Morand. First part—"Coal and Coal Mines." Paris: 1768. Second part—"Theoretical and Practical Essay on the Different Applications of Coal for Manufactories, Factories, and Domestic Use." Paris: 1777. This work contains a description of Genssane's method by which bitumen was obtained from coal by a downward distillation. The apparatus employed appears to have been a clay retort which when filled with coal was closed; at the bottom of the retort was a gutter, and only one outlet supplied with a long copper pipe inclined downwards; this pipe communicated with a cast-iron vessel to receive the bitumen flowing out. Another copper pipe rising vertically was fixed to the descending pipe, and served for the evaporation of the 'sulphur vapours.' The retort was heated until it became slightly red, and at that degree of heat the bitumen was said to flow into the receiver. The bitumen is described as very greasy, and suited for greasing carriage wheels. The oil is said to differ from petroleum in being less inflammable.] If I understand this process correctly, it is a process for fusing out bituminous constituents rather than distilling them; the oil collects in the bottom of the retort and flows out; it is not volatilised in this case. It must exist in a state of vapour before it collects. The heat is described as a light red; it is not the same expression, but it may be taken as the same as that described by Mr. Young. I am not prepared to say that it would be the same oil. Supposing the same coal to be used, I admit that you would obtain an oil somewhat similar. [An extract from the 'Encyclopédie Methodique (Paris and Liège, 1782,) describing the same works was now referred to.] The method is now referred to as one for "desulphurising coal;" in this process an oil is incidentally produced. It would appear to be same as that of Genssane [the last referred to]. [An extract from a book by M. Sage, "Observations sur la Physique," was now produced and read as follows:—The peculiar characters of cannel coal are due to the quantity of bituminous oil that it contains. This cannel coal yields by distillation one-third of its weight oil. Newcastle coals contain nearly as much bitumen as cannel coal.] This is a general statement, such as you find in chemical works generally. There are different qualities of coal which yield different quantities of oil. I have heard of M. Selligue's process. [The account of it is given in the Jury Report on the exhibition of French industrial products in 1839. The oil is distilled from schist, and on redistilling the crude oils, they are separated into a drying oil, an oil suitable for burning in special lamps, a bituminous residue, a lubricating substance, and lastly, paraffine.] I saw candles made by Selligue in the London Exhibition of 1851. The substances obtained by Selligue, with the exception of the paraffine, are so ill defined that I could give no opinion upon them. The crude oil, from which the drying and the burning oil, &c., are obtained, would probably be produced from schist at the range of temperature described by Mr. Young. I have never seen the French schist, but I have obtained by distilling Dorsetshire shale products, especially paraffine, which inclines me to believe that a temperature of a low red heat would probably yield analogous products. I know Lord Dundonald's specification. [It is dated 1781, "for making tar, pitch, gas, &c., from coals." The following extract from the specification will give our readers an idea of the process. It is declared that "persons who shall extract tar, pitch, essential oils, volatile alkalies, mineral acids and salts, from pit coals in vessels or buildings (it matters not their shape or size), whereby the coals are made to burn or ignite without flaming by a regulated admission of the external air through different apertures in the buildings, so as by their own heat to throw off the tar, oils, &c., that they contain; persons who do so without permission are deemed to encroach upon my patent; as the only method known or used until my new discovery was distillation of coal in close vessels, where the admission of external air was prevented."] It is evident with this patent that you must employ a high temperature, for the object is to obtain pitch and coke. There is an extension of the patent. The pitch is produced in the first operation, but is obtained in a subsequent process by the separation of the more volatile from the less volatile products. I have said that the great principle of Mr. Young's invention is the use of a graduated and moderate temperature and the selection of proper coal. ["Ure's Dictionary," edition 1821, was now referred to. The extract read was the following:—"If coal be put into a cold retort and slowly exposed to heat its bitumen is merely volatilised in the state of condensible tar; little gas, and that of inferior illuminating power, is produced. This distillatory temperature may be esteemed at 600° or 700° F. If the retort be previously brought to a cherry-red heat, then the coals, the instant after their introduction, yield a copious supply of good gas, and a moderate quantity of tarry and ammoniacal vapour."] This passage refers chiefly to the manufacture of gas, and appears to say that if the heat be very strong a gas is obtained of inferior illuminating power; and that if it be very low you obtain little or no gas, but substances which he describes as bitumen or condensible tar. He states the temperature to be 600° or 700° F. I do not believe the coals Mr. Young employs in his operations give off any bitumen or condensible tar at 600° or 700° F. If this bitumen is given off at 600° or 700° F., the kind of coal used must be essentially different from that Mr. Young employs. Dr. Ure speaks of gas coal, but of a kind of coal which yields volatile matter at 600° or 700° F. I think there is some discrepancy in the temperature. I gave the range of temperature [of a low red heat] from 800° to 1000°, but one man may take it as little more than 800° and another near to 1000°. The general belief now is that it is nearer to 1000° than 800°. Dr. Ure, in his book, gave it as 812°. [The next extract referred to was from a paper by Dr. Henry in the "Annals of Philosophy," 1819. It was as follows:—"The temperature to which coal is subjected must necessarily be a point of the greatest importance to the quantity and quality of the aeriform products; for, while too low a point distils over, in the form of a condensible fluid, the bituminous part of the coal which ought to afford gas, too high a temperature, on the contrary, occasions the production of a large relative proportion of the lighter and low combustible gases. With the view of ascertaining how low a degree of heat is adequate to the production of gas from coal, I placed a small iron retort . . . about the fusing-point of lead . . . a dull red or blood-coloured heat. This temperature I suspect is rather too low, and has a tendency to distil over too much tar."] This statement appears incompatible. The author speaks of the fusing-point of lead, and calls it a dull red or blood-coloured heat. At about the fusing point of lead you could not possibly obtain a dull red or blood-coloured heat. [It is right to say that the extract, as read by the Attorney-General, is garbled. Dr. Henry does not speak of the fusing of lead as a dull red or blood-coloured heat. It was a separate experiment, in which a Wedgwood pyrometer was used to indicate the temperature]. Dumas' "Chemistry Applied to the Arts" (1828) was next quoted. "Coal exposed to a bright red heat in a close retort is rapidly decomposed, yielding coke, tar or oil, water and gas. The relative quantities of each of these substances differ not only according to the varieties of the coal, but of the temperature. Experience has shown that the quantity of oil or tar, as well as that of coke, is greater when the temperature is low. The proportion of gas, on the contrary, is greater at a high temperature; that is to say, more gas is obtained the less oil is produced. In making illuminating gas, the retorts are in the first place brought to a cherry-red heat."] In this passage there is a general statement of the necessity, in the manufacture of gas, of a high temperature. Cherry-red, I would say, is a good red—a bright red heat. [Kane's "Elements of Chemistry" (1841) was next quoted from. The author having mentioned fossil wax and rock oil, &c., proceeds:—"The products of the distillation of coal in close vessels possess a remarkable analogy to those that have been now described. . . . . . The liquid products consist of various bodies closely analogous to petroleum, and the solids consist of naphthaline and paraffine. The relative proportions of these products vary with the temperature. The lower the heat employed the less gas and the more solids and liquids are produced.] The liquid products may or may not correspond to the crude oil of Mr. Young according to the nature of the coals and the temperature. Kane says that to get those liquid products analogous to petroleum you should employ a lower heat; but it is not so with regard to solids. The temperature for naphthaline should be high, and for paraffine low.

Re-examined by Mr. Bovill: We need not give the re-examination at great length. The papers of Reichenbach were first referred to, and in answer to the question whether these papers are of any practical value in procuring paraffine as a commercial article, Dr. Hofmann stated that the papers were essentially of a scientific nature. Reichenbach certainly had a commercial article in view, but he did not get it; Mr. Young did succeed. The statement that paraffine is a product of the carbonisation of all organic substances is a mistranslation. The correct translation is that paraffine is a product of the carbonisation of animal tar, vegetable tar, and pit coal tar. Reichenbach's experiments on the distillation of coal were laboratory experiments. He states that he always obtained eupion, picamar, creosote, paraffine, moder, sulphur, &c. I have never seen picamar; I cannot say whether it is present in Mr. Young's oils; I do not think that moder or sulphur is present; I do not know whether creosote is present or not. Eupion may or may not be present; but the properties of eupion given by Reichenbach do not correspond with those belonging to Mr. Young's oil. With regard to the various specifications referred to in the cross-examination, not one informs the public how they could practically make paraffine for commercial purposes from bituminous coal, or discloses Mr. Young's process. Nothing that had been done with shale would enable a person to know with certainty that he could produce a similar effect with bituminous coals without experiments. Mr. Young's general description of coals would be well understood. Boghead would, according to my belief, be properly called a cannel coal. Coal is not a definite chemical compound; it is difficult to trace the line of demarcation between coal and stone. I could not tell the properties of a coal from mere inspection or by scratching with a knife. I could not do so at all without I had an opportunity of making a chemical examination of it. I never heard boghead cannel called schist until the trial of Gillespie *v.* Russell. [The celebrated Torbane-hill mineral case. The question whether boghead was a coal or a schist was not decided at the trial. The scientific evidence was pretty equally balanced on the question.] In my judgment boghead mineral is a different thing from shale. I distilled shale, to ascertain whether similar results could be obtained from it, in 1857. I obtained very little paraffine from it, and the oils had a nauseous odour; they had to be submitted to a succession of chemical operations to deprive them of their odour. In Genssane's process, described by Morand, coals are said to lose one-eighth of their weight, in Mr. Young's process as much as 50 per cent. is volatilised. According to my belief, Genssane's plan is not a practical mode of making Mr. Young's oil. A great deal of the oil if it were produced would be lost, being carried off by the perpendicular tube which communicates with the atmosphere, and which is placed just at the point where the products emerge from the furnace. Du Buisson's is a process of distillation like Mr. Young's, but he makes use of bituminous schistus, clay slate, &c. The heat employed, it is said, must not exceed a cherry red, which is very different to a low red heat. The materials differ, and the process differs from Mr. Young's. Du Buisson states of his oil that it saponifies very well, and appears to derive a great part of its properties from the presence of paraffine. Mr. Young's oil will not saponify. I have never made the experiment, but I know from the nature of the substances that it will not. Du Buisson's statement that paraffine is contained in the largest proportion in schistus would mislead a person with respect to bituminous coals. Experiments would refute Du Buisson's opinion. No person from reading his specification would be aware that paraffine could be obtained from bituminous coals. [A question was here asked about the composition of paraffine and paraffine oil, and at the request of the Vice-Chancellor, Dr. Hofmann went into the chemistry of the matter. We give an abridgment of his statement.] When paraffine was first examined, it was said to have the same composition as olefiant gas, but this was subsequently denied by Lewy, who stated that he found for one part of hydrogen 5·95 parts of carbon. The subject was pursued in this country by Professor Anderson, Sir Benjamin Brodie, and others. Professor Anderson examined two varieties of paraffine, one from Boghead cannel and another from Rangoon tar. Lewy's experiments were made with paraffine obtained by the distillation of wax. Professor Anderson found that paraffine is not an individual compound, but a mixture of several compounds. Amongst these he admits the existence of one having the same composition as olefiant gas, and another having the composition given by Lewy; he adds that there are probably several in which one part of hydrogen is contained with 5·95—5·96 of carbon. Sir B. Brodie's experiments led him to the conclusion that paraffine had the same composition as olefiant gas, and I believe he is correct. The liquids are not a pure chemical substance, but a mixture of substances. In fact, paraffine oil boils between 300° and 500°. A pure chemical substance boils at a fixed temperature. Water, for instance, boils at 212°, and alcohol at 172°. But mixtures of water and alcohol boil at intermediate temperatures. Now, paraffine oil is a mixture of substances boiling between 300° and 500°. These substances have been examined, and several individuals have been isolated, which undoubtedly have the same composition as olefiant gas. But some have been found which contain a less quantity of carbon than olefiant gas; so it is impossible to say that the oils have the same composition as olefiant gas. An experiment of Sir B. Brodie will elucidate the question. He took a bent tube, introduced some paraffine, and then sealed the open end. He thus had a glass tube containing paraffine, closed at both ends. He then applied heat to the paraffine until it passed to the other end of the tube, and afterwards distilled it back again. After two distillations he found that the paraffine would no longer solidify, and after distilling it six or seven times the tube burst from the production of gas. The liquid portion no longer contained a trace of solid paraffine, but was found to consist of an oily substance boiling between 300° and 500°. So that to my mind Sir B. Brodie has succeeded in converting paraffine into paraffine oil, and at the same time into olefiant gas, which was obviously the cause of the explosion.

The other subjects upon which Dr. Hofmann was examined will be better understood from the evidence of subsequent witnesses. We have necessarily given Dr. Hofmann's evidence at some length. With the other witnesses for the plaintiff we shall only give such evidence as may be contradictory, or in which new matters are introduced.

The judgment in this important case is being delivered as we go to press, and we shall give it next week. On announcing his intention to deliver his judgment, the learned Vice-Chancellor remarked that the case had given him great labour out of Court, which he would not regret if it had advanced the administration of justice one whit. But the fact was, that nineteen-twentieths of the evidence was foreign to the case, and only increased the expense, and delay and loss of time to the public. After perusing much of the evidence, we quite agree with the Vice-Chancellor, that the greatest part was foreign to the case; but as some points of general interest to chemists and to manufacturers were introduced, we shall continue our abridgements.

(To be continued.)

The Medical Council and Pharmacy.—At the last meeting of the Council the following resolution was moved by Dr. Corrigan, seconded by Dr. Quain, and agreed to:—"That a communication be addressed to the Secretary of State for the Home Department, drawing his attention to the present defective state of the law regarding the practice of pharmacy, under which any person, however ignorant, may undertake it; and expressing the opinion of the General Medical Council that some legislative enactment is urgently called for to insure competency in persons keeping open shops for dispensing medicines and for the compounding of physicians' and surgeons' prescriptions."

ANSWERS TO CORRESPONDENTS.

Mr. Newland.—Received with thanks. The cause of the error will be inquired into.

Mr. W. Sydney Gibbons.—Received, with thanks.

A Manufacturer.—We have answered your question many times. The Commissioners will not sell the Chemical Report separate from the others.

G. W.—The estimation of small quantities of starch is a very difficult matter. The process you mention is, perhaps, the best for the purpose. It will be necessary to boil for some time; a very little acid will suffice.

Errata.—Page 240, column 1, *for* carbonic acid *read* carbonic oxide. We have also to correct a slight error in the percentage calculation of the water in thallium-iron alum, p. 205. In place of 31·147, it should be 32·019.

S. T. B. will see the correction above.

Book Received.—"Class Book of Rudimentary Chemistry." By the Rev. Geo. Pope, M.A.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

A New Method of Producing Aldehydes, by M. CARSTANJIN.

THE different processes for preparing aldehydes consist essentially in—

1st. The oxidation of alcohols.

2nd. The oxidation of nitrogenised matters, such as albumen, gelatine, &c.

3rd. The dry distillation of salts from fatty acids.

4th. The same distillation conducted with that of the formiates of lime and baryta.

5th. The distillation of albuminoid substances.

6th. The dehydration of glycols.

On the strength of several observations, the author thinks himself justified in laying it down as a general fact that an aldehyde is always to be obtained by submitting an ammoniacal base to a proper oxidation. Among them is the acetic aldehyde $C_4H_4O_2$ rapidly developed when ethylamine is poured on crystallised permanganate of potash. At first violet, the liquid turns green, develops heat on shaking, becomes brown with effervescence, and finally evolves the aldehyde, so perceptible by its odour. The gas of the reaction passed into an ammoniacal solution of silver, promptly reduces it, forming a metallic silver mirror.

With methylamine he has obtained a strongly reducing gaseous compound like the above, and, like it, capable of forming a crystalline compound with ammonia. He has not analysed it, but believes it to be the hitherto unfound aldehyde of methyle.

With trimethylamine a compound is produced which the author believes to be identical or isomeric with propylamine.—*Journal de Pharm. et de Chemie*, xlv., 100. 64.

A New Quadruple Salt, by M. PELTZER.

BY treating sulphate or acetate of copper by hyposulphite of soda there results, as is well known, a double sulphite, which has been studied by M. Lenz and M. Rammelsberg. This hyposulphite is soluble in ammonia, to which it imparts a blue colour, and when left to itself the solution deposits a mass of blue crystals which constitute the new salt.

It may be obtained still more easily in the following manner:—Divide into two equal parts a mixture of sulphate of copper; supersaturate one with ammonia and the other with hyposulphite of soda, and mix the two solutions; by shaking the mixture, the new product is deposited in a crystalline mass of a beautiful violet colour.

The latter gives out a decided ammoniacal odour, especially if reduced to powder; it will bear a temperature of 100° C. Heated in a tube it loses no water, but forms a white sublimate which becomes orange by cooling. When boiled with water this sublimate emits ammonia, and on the addition of hydrochloric acid there follows a disengagement of sulphurous gas, which shows the sublimated product to contain M. H. Rose's sulphate—ammon.

Mixed with chlorate of potash, it detonates with some violence.

Water, especially when hot, decomposes but does not dissolve it; a green matter and white flakes of a salt of protoxide of copper are formed, and ammonia is disengaged; by prolonged boiling sulphide of copper is formed.

The new salt is soluble in ammonia, hyposulphite of soda, and acetic acid. Heated with potash it deposits at the boiling point a mixture formed of protoxide and deutoxide of copper.

The solar rays decompose the acetic solution, hypochlorite of soda also destroys it, forming a white precipitate containing protoxide of copper and tetrathionic acid.

Nitrate of silver produces a white precipitate; the precipitate, however, soon disappears to give place to a green deposit soluble in ammonia, but easily giving a deposit of sulphide of silver. The deposit contains copper, silver, and hyposulphurous acid. The author is of opinion that iron, zinc, and silver may be substituted for copper; besides, ferruginous sulphate of copper gives a quadruple salt containing iron.

The author has found for the percentage composition of this salt—

Cu_2O_2	27·76
NaO	15·52
NH_3	8·52
S_2O_2	48·19

thence he deduces the formula—

$$S_2O_2Cu_2O,S_2O_2CuO + 2(S_2O_2NaO) + 2AzH_3{}^{*}.$$

According to him ammonia here plays only a passive part, acting in the same way as water of crystallisation. —*Journal de Pharmacie et de Chemie*, xlv., 101. 64.

TECHNICAL CHEMISTRY.

The Formation of Aniline Yellow.—Researches on Aniline Colours, by M. SCHIFF.

Aniline Yellow.—This matter, which M. Schiff has often produced in the course of his researches on aniline colours, is, according to him, easily prepared by means of hydrated antimonic or stannic acid.

The alkaline antimoniate or stannate is pounded with half its weight of aniline, to the consistence of a clear *bouillie*, then hydrochloric acid is added till the acid reaction takes place. It is then shaken up, and the scarlet colour removed by etherised alcohol, the mass being, of course, previously dried. After proper purification it is allowed to evaporate spontaneously, and in this way are formed flakes of a hydrochlorate, having for base a red colouring matter, which must not be confounded with rosaniline.

When this hydrochlorate is decomposed by alkalies, deep yellow flakes are deposited, which again become red in presence of acids.

By impregnating silk or wool with this red colour, and then passing it into a hot solution of carbonate of soda, a beautiful yellow tint is developed, similar to the yellow of picric acid, and which the author believes to possess considerable stability.

Aniline yellow, then, may be developed on the stuff itself, by first producing the red above described, which, as has been shown, may easily be done by means of the stannate of soda so much used in dyeing.

The author has not yet decided on the composition of these colouring matters, but intends making them the subject of a future communication.—*Journ. de Pharm. et de Chem.*, xlv., 110, 1864.

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[*] This empirical formula may be decomposed into—

$$S_2O_2Cu_2O{\cdot}S_2O_2NaO + S_2O_2CuO,S_2O_2NaO + 2AzH_3.$$

which gives a quadruple salt differing from those already known only in containing three different bases and one acid.

PHYSICAL SCIENCE.

On the Electrical Relations of Metals, &c., in Fused Substances, by GEORGE GORE, *Esq.*

IN the following experiments most of the substances to be fused were contained in small porcelain crucibles, and heated by means of the flame of a Bunsen's burner; the more infusible bodies were melted in clay crucibles in one of my small gas furnaces, particular care being taken to have neither an excess of gas nor of air in the furnace, by testing at the top of the chimney for carbonic oxide by means of a brightly red hot rod of iron, and diminishing the supply of gas until all traces of carbonic oxide precisely disappeared. The condition of the contents of the crucible could at all times be ascertained without admitting air into the furnace by placing upon the top of the furnace a vertical tube of fireclay about four inches high closed at its upper end by a thin disc of glass.

The materials of which the electrodes were composed included carbon, magnesium, aluminium, silicium, zinc, tin, lead, iron, nickel, copper, silver, gold, and platinum. The carbon consisted of bars of gas-graphite as used for electric lamps; the magnesium was a rod of Mr. Sonstadt's purest variety; the aluminium was obtained from Messrs. Bell, of Newcastle; the silicium was in the form of lumps obtained by fusing the finest crystals under a mixture of powdered Bohemian glass, silico-fluoride of potassium, and a little hydrate of potash; the zinc, tin, and lead were of the best commercial kinds; the iron was "pianoforte wire;" the rod of nickel was kindly given to me by Mr. H. Wiggin, of the firm of Evans and Askin, Birmingham; the copper was ordinary wire of commerce; the silver and gold were of "virgin" quality; and the platinum was obtained from Messrs. Johnson and Matthey, London.

The most superficial consideration of the conditions of these experiments will show that a number of interfering circumstances were more or less necessarily present, and that the results obtained are not in all cases simply and purely due to chemico-electric action; for instance— 1. thermo-electric action of the heated and immersed ends of the electrodes; 2. Ditto of the ends of the electrodes out of the fused substance, which in many cases could not be removed a sufficient distance to be out of the influence of the heat; 3. The chemical influence of infusible or insoluble films formed upon the immersed electrodes; 4. The accumulation of liquid of different composition around the electrodes; 5. Evolution of gases at the electrodes; 6. Alteration of structure of the electrodes by heat, their semifusion, etc.; 7. Currents occurring when by the relative coldness of the electrodes the fused salt around them solidified; and 8. In addition to all these, the interference of impurities in the fused substances and in the electrodes themselves.

It will at once be seen that some of these interferences could not be prevented or avoided; with regard to the others every reasonable precaution was taken, and the results in each uncertain case properly verified.

In the following lists the most positive substance is in each case named first, and substances united by the mark — were about equally positive:—

With fused boracic acid the following order of electrical relations was found: Iron, silicium—carbon, platinum, gold, copper, silver. The currents obtained were very feeble.

Glacial phosphoric acid: Zinc, iron, copper, silver, platinum. The copper, iron, and zinc dissolved quickly; some of the gas evolved by the zinc exploded.

Large crystals of iodine which had long been exposed in a bottle near lumps of fused chloride of calcium, gave, when fused, feeble currents with silver and platinum, the former being positive.

Fused selenium yielded no currents with platinum and copper or silver.

Sulphate of ammonia: Zinc, copper, silver, iron, platinum, carbon. Copper evolved much gas, and dissolved violently.

Nitrate of ammonia: Magnesium, zinc, lead, copper, silver, tin, aluminium, iron, silicium—carbon, platinum. Lead was very strongly positive to copper without manifesting strong chemical action. Zinc evolved gas violently.

Hydrate of potash: Silicium, aluminium, zinc, iron, lead (?), carbon, copper, platinum, silver. Silicium was strongly positive to aluminium, and strongly acted upon with evolution of gas. The results were variable with copper and platinum, and with platinum and silver.

Borate of potash: Iron, zinc, copper, silver, platinum.

Phosphate of potash: Zinc, iron, copper, silver, platinum.

Sulphide of potassium: Aluminium, zinc, copper, silver, platinum, carbon, iron. Copper and silver dissolved rapidly with violent action. Reversals of current occurred with platinum and aluminium, silver and aluminium, aluminium and zinc, iron and platinum, iron and carbon, silver and copper.

Iodide of potassium: Aluminium, zinc, iron, silver, copper, platinum. Reversals of current with copper and silver, copper and platinum, iron and zinc, probably from salt solidifying round the electrodes and subsequently fusing.

Bromide of potassium: Zinc, iron, copper, silver, platinum. Reversal of current with iron and zinc.

Chloride of potassium: Aluminium, zinc, iron, copper, silver, platinum. Reversals with silver and platinum, silver and copper, silver and iron, iron and copper, iron and zinc.

Chlorate of potash: Zinc, aluminium — iron, silver, copper, platinum. The currents were feeble; they were also indefinite until gas was evolved.

Nitrite of potash: Aluminium, zinc, copper, silver, iron, platinum.

Nitrate of potash: Tin, lead, aluminium, carbon, copper, iron, zinc, platinum, silver. Currents very feeble. Reversals with iron and platinum, iron and silver, carbon and copper. Carbon evolved much gas.

Hydrate of soda: Zinc, iron, carbon, copper, silver, platinum. Reversals with silver and platinum, copper and iron, carbon and iron. Moving either platinum or silver made each more positive.

Biborate of soda: Zinc, carbon, iron, copper, silver, platinum. Iron and zinc evolved gas.

Mono-pyrophosphate of soda: Iron, copper, silver, carbon, platinum. Reversal with silver and carbon.

Sulphide of sodium: Zinc, copper, silver, iron, platinum, carbon. Reversals with iron and carbon, iron and platinum, iron and silver. Iron much dissolved.

Hyposulphite of soda (aqueous fusion): Zinc, carbon, copper, silver, iron, platinum.

Bisulphate of soda (aqueous fusion): Iron, copper, silver, carbon, platinum. Reversal with iron and platinum. Gas evolved by iron.

Iodide of sodium: Iron, silver, copper, carbon, platinum. Reversals with platinum and silver, platinum and copper, platinum and carbon, carbon and copper, copper and silver, copper and iron, silver and iron.

Bromide of sodium: Zinc, iron, copper, silver, platinum. Reversals with platinum and silver, iron and zinc.

Chloride of sodium: Iron, copper, carbon, silver, gold, platinum. Reversals with carbon and copper, carbon and iron.

Nitrate of soda: Aluminium, zinc, carbon, copper, silver, iron, platinum. Reversals with silver and iron, carbon and copper, iron and copper. Carbon evolved much gas.

Microcosmic salt, aqueous fusion: Zinc, iron, silver, copper — platinum, carbon.

A mixture of carbonates of potash and soda: Silicium, iron, zinc, carbon, copper, silver, platinum. Reversals with platinum and silver, silver and copper, copper and carbon. Silicium was strongly positive to iron, and much action and gas at the surface of silicium.

A mixture of fluorides of potassium and sodium: Silicium, iron, carbon, copper, silver, platinum. Electric currents strong. Silicium rapidly acted upon and dissolved, and evolved much gas.

Carbonate of lithia: Iron, carbon, copper, silver, platinum. Reversals with platinum and silver, copper and carbon. Much effervescence.

Iodide of barium: Iron, carbon, silver — copper, platinum. Reversal with copper and silver; either was positive when moved. Silver freely dissolved.

Bromide of barium: Iron, carbon, copper, silver, platinum. Reversals with silver and copper, copper and iron, carbon and iron.

Nitrate of baryta: Zinc, carbon, copper, silver, iron, platinum. Reversal with copper and silver. Carbon evolved much gas, which appeared to make it negative to copper, and to silver especially. Iron evolved much gas.

A mixture of caustic baryta and the fluorides of potassium and sodium: Silicium, iron, carbon, copper, silver, platinum. Carbon evolved gas, iron much gas, and silicium very much gas.

Nitrate of strontia: Carbon, platinum, iron. Reversal with iron and platinum.

Iodide of calcium, aqueous fusion: Silver positive to platinum.

Bromide of calcium, aqueous fusion: Zinc, copper, iron, platinum.

Nitrate of lime: Silver, copper, platinum, iron, carbon.

Nitrate of magnesia, aqueous fusion: Zinc, silver, iron, silicium, carbon, platinum.

Silicate of potash (water glass): Copper, silver, platinum.

Bohemian glass: Carbon positive to iron. Current feeble.

A mixture of fine white sand and hydrate of potash: Nickel positive to carbon.

Silico-fluoride of potassium: Silicium, iron, carbon, copper, silver, platinum. Iron and silicium evolved gas.

A mixture of soda-lime, white sand, and hydrate of soda: Carbon strongly positive to nickel.

Tungstate of soda: Aluminium, iron, copper, silicium, carbon, silver, gold, platinum. Reversal with gold and carbon.

Molybdic acid: Copper, silver, platinum, carbon. Silver and copper acted upon.

Bichromate of potash: Silver, copper, silicium, carbon, iron, platinum, gold. Reversal with copper and silver.

Chromate of soda: Iron, copper, carbon, silver, platinum, gold. Currents strong.

Chloride of manganese: Copper, silver, iron, carbon, gold, platinum. Currents strong.

Bisulphide of arsenic: Silver, iron, carbon. Silver dissolved rapidly.

Tersulphide of arsenic: Copper, iron, platinum.

Teriodide of arsenic: Silver positive to platinum. Bad conductor.

Arsenite of soda: Iron, silicium, carbon, silver, copper, platinum. Reversals with silver and carbon. Iron, silicium, and carbon evolved much gas. Platinum, copper, and silver rapidly melted in it.

Teroxide of antimony: Silicium, iron, carbon, copper —silver, platinum. Reversal with silver and copper.

Tersulphide of antimony: Silver, copper, zinc, iron, silicium, platinum, carbon. Reversals with platinum and iron, copper and silver. Copper and silver dissolved quickly.

Teriodide of antimony: Silver, zinc, copper, iron, carbon, platinum. Currents feeble.

Terbromide of antimony: Copper, silver, zinc, iron, platinum, carbon. Reversal with zinc and iron. Currents very feeble.

Oxybromide of antimony: Silicium, iron, copper, silver, carbon, platinum, gold. Silver and copper dissolved quickly.

Fluoride of antimony: Zinc, iron, copper, silver, carbon, platinum. Iron coated itself black.

Bromide of zinc: Copper, iron, silver, platinum.

Chloride of cadmium: Aluminium, zinc, iron, copper, silver, platinum. Reversal with silver and copper. Zinc melted quickly; aluminium similar, with violent action.

Mineral phosphate of lead: Iron positive to carbon. Strong action upon iron, and iron dissolved; gas also evolved from carbon. Much lead reduced to a metallic button.

Iodide of lead: Zinc, silver, copper, iron, platinum. Reversals with platinum and iron, silver and zinc. Copper and silver dissolved rapidly.

Chloride of lead: Zinc, lead, copper, iron, silver, platinum. Reversals with copper and silver, copper and iron.

Chromate of lead: Carbon positive to iron. Strong action and intense heat at surface of iron. Iron much dissolved; carbon also corroded.

Black scale oxide of iron mixed with silica: Iron, carbon, platinum. Reversal with iron and carbon. Current strong with iron and platinum. Iron dissolved.

Black oxide of copper: Platinum positive to iron as long as the iron was enveloped by an unfused coating of oxide of copper, then violent action upon the iron, attended by evolution of intense heat and very rapid solution of the iron, the iron becoming, at the same time, strongly positive to platinum. A large button of reduced copper was formed. Protoxide of copper appears to evolve oxygen gas when fused.

The following inferences may be deduced from these experiments:—

The most negative substances in fused salts are generally platinum, gold, carbon, and silver; the most positive substances are generally magnesium, aluminium, and zinc. Silicium is generally electro-positive to carbon, and is strongly positive and quickly corroded in fused alkalies, alkaline carbonates, or fluorides. Carbon is not, generally very positive to iron.

The following facts may also be noticed:—

Copper and silver dissolve rapidly in fused sulphide of potassium, tersulphide of antimony, or iodide of lead; silver also dissolves freely in iodide of barium and bisulphide of arsenic. Platinum, copper, and silver rapidly melt in fused arsenite of soda. Electric currents were repeatedly observed whilst one (or both) of the electrodes was coated with unfused salt, and on the fusion of the saline coating strong currents in an opposite direction generally occurred.

The investigation was very suggestive of new experiments; it suggested the examination of the various phenomena which acted as sources of interference, which I have already enumerated; it also threw light upon the desirable object of obtaining a cheap source of electricity by the combustion of coke or gas carbon. The discovery of some suitable fused salt or mixture in which carbon is highly electro-positive at a high temperature to iron, nickel, or other infusible and suitable conductor would probably prove a cheap and powerful source of electricity; cheap because of the low equivalent number of carbon and the low price of coke and gas carbon, and powerful because of the intense affinity of carbon for oxygen at high temperatures—sufficient, indeed, to set the alkali metals free from their oxides. The nearest approach in these experiments to this object was with carbon and nickel in a fused mixture of soda, lime, and silica.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 15, 1864.

"*On the Chemical History and Application of Gun-cotton,*" *by Professor* Abel, *F.R.S., Chemist to the War Department.*

(Continued from page 257.)

Many attempts have been made from time to time to diminish the rapidity of explosion of gun-cotton, but the only one which has been attended by any success is that which, in General von Lenk's hands, has led to the development of a system of mechanical arrangement of gun-cotton as ingenious and simple as it is effective. By manufacturing the cotton into yarn of different thickness and degrees of compactness or firmness of twist, *before* its conversion into gun-cotton, this material is at once obtained in forms which not only burn with great regularity and much less rapidity, when used in the original condition, than the loose gun-cotton wool, but which also, when employed in the form of reels, wound more or less compactly, or, by being converted into plaits or hollow ropes, may be made to burn gradually in a manner similar to gunpowder, or to flash into flame instantaneously, exerting an explosive action which very far exceeds that of the latter. The modifications in the nature and degree of explosive force exerted by gun-cotton which are essential for its application to military and industrial purposes as a substitute for powder are, therefore, arrived at by means of very simple variations in the mechanical condition of the material. Thus, to obtain the gradual action essential for the employment of gun-cotton in cannon, cartridges are made up of coarse yarn, which is wound firmly round a hollow cylinder of wood, the dimensions of which are regulated by the size of the gun-chamber and the weight of the charge used; the best result is obtained by so arranging the latter that the cartridge entirely fills the space allotted to the charge in the gun. Similarly, small-arm cartridges are made of cylindrical plaits of fine yarn or thread, which are fitted compactly in layers, one over the other, upon a small cylinder or spindle of wood. In both of these arrangements the combustion of the charge can proceed only from the exterior surfaces towards the interior of the cartridge. On the other hand, the charges for shells, in which the most rapid explosion is most effective, and the priming for quick-matches which are intended for firing several charges simultaneously and almost immediately upon the application of flame, consist of cylindrical, hollow, and moderately compact plaits (similar to lamp-wicks), made of gun-cotton thread or very fine yarn. These plaits are produced in pieces of any length, and, when employed as quick-match, are compactly enclosed in cases of waterproof canvas or other similar materials. The charges to be used in mines, in which the most destructive effects are aimed at, consist of pieces of very firmly twisted rope, with a hollow case along the centre, the number of strands of which it is composed varying with the size of the charge to be used. For quarrying and blasting purposes suitable lengths of the rope are employed singly; for military operations (demolition of works, &c.), it is packed into moderately stout cases of sheet metal. In these hollow ropes and plaits of gun-cotton, the flame produced by the burning of that portion to which heat is applied, penetrates at once to the interior and into the interstices of the charge; and hence the entire mass of gun-cotton is converted into gas and vapour with almost instantaneous rapidity. A striking illustration of the very opposite effects which can be produced by very simple modifications in the mechanical arrangement of the gun-cotton is afforded by the following experiment:—If two or three strands of gun-cotton yarn be very loosely twisted together and inserted into a tube of glass or other material, in which they fit so loosely as to be readily drawn backwards and forwards, upon applying heat to a projecting portion at one end of the tube, the gun-cotton thus arranged will explode with great violence, completely pulverising the tube, if it be of glass, and the combustion will take place with such almost instantaneous rapidity that small portions of unburnt gun-cotton will actually be scattered by the explosion. But, when two or more strands of the same gun-cotton yarn be tightly twisted, singly in the first instance, then made up into a firm cord solid throughout, and enclosed in a glass tube, or some other description of case, into which the cord fits very tightly, if a protruding end of the gun-cotton be inflamed, the cord will burn with moderate rapidity until the fire reaches the opening of the case, and then the combustion will pass over from the ordinary kind to a form which can only be described as a smouldering: the lighted extremity of the gun-cotton simply glows within the case, while a steady jet of flame (furnished by the combustible gases evolved from the gun-cotton) continues to burn at the open extremity of the case until the contents of the latter are consumed. The gun-cotton not only burns extremely slowly under these conditions, but also with the greatest regularity; so that the rate of combustion of a given length of the enclosed cord may be accurately timed. The rapidity of combustion of gun-cotton arranged in this form may be regulated by the number of strands in a cord and the degree of their compactness; and it is by this new modification of General von Lenk's system of arranging gun-cotton that the lecturer has succeeded in applying this material to the production of slow-matches and time-fuses—uses for which it had not previously been found suitable.

Reference has just been made to inflammable gases evolved by gun-cotton while it undergoes a very slow combustion. The composition of gun-cotton renders it self-evident that under any circumstances the explosion of this substance must be accompanied by the production of a very considerable proportion of carbonic oxide. The large body of flame always observed when gun-cotton is ignited under ordinary circumstances, is principally due to the combustion of carbonic oxide, and probably also of small quantities of carbo-hydrogen compounds, which, together with minute suspended particles of the mineral matter contained in the gun-cotton, give to the flame its brightness. If a tuft of gun-cotton be ignited in a capacious and somewhat deep vessel, the flame actually resulting from the burning of the tuft may be distinctly seen surrounded by a large body of flame, produced by the burning gases, which continues apparent for a very appreciable time after the disappearance of the flash of flame furnished by the explosion of the gun-cotton. If similar tufts be ignited in atmospheres of hydrogen, nitrogen, carbonic acid, coal-gas, &c., the combustion of the gun-cotton is only accompanied by a very small and pale flame, of instantaneous duration. Similarly, if gun-cotton be ignited in a vessel which has been previously exhausted to any rate one half the ordinary atmospheric pressure, the proportion of air, and therefore of oxygen, present when the gun-cotton is ignited, does not suffice to effect the combustion of any large proportion of the inflammable gases generated, and hence the explosion of the gun-cotton is attended only by a small pale flame. If, however, the vessel be filled with oxygen, and then exhausted to an equal or even a lower degree, it is filled with flame of dazzling brightness directly the ignition of the gun-cotton is effected.

The one modification, just referred to, of the phenomena which attend the ignition of gun-cotton in a rarefied atmosphere is not the only result observed in experiments of this kind. Various curious effects may be obtained, their nature being determined by the degree of rarefaction of the atmosphere; the mechanical condition of the gun-cotton; its position with reference to the source of heat employed; and other variable elements in the experiments. A brief account of some of the principal of these phenomena may not be without interest.

In the experiment with a tuft of gun-cotton in rarefied air, spoken of just now, a perceptible interval is observed between the first application of heat (by passage of a voltaic current through a platinum wire enclosed in the tuft) and the first appearance of ignition of the gun-cotton; moreover, the pale flame, observed when the latter does burn, is of very perceptibly longer duration than that of the bright flash which attends the explosion of gun-cotton in air under ordinary conditions. If, instead of using the gun-cotton in the form of a tuft, a short piece of the gun-cotton-yarn be employed in the experiment, and laid on a support so that it rests upon the wire by which it is to be ignited, the pale flame of the burning gun-cotton will travel along towards the two extremities of the piece of yarn with a degree of slowness corresponding to the extent of rarefaction of the atmosphere. These results are in perfect accordance with the observation first made by Quartermaster Mitchell, afterwards fully examined into by Frankland, and recently amplified by Dufour, that the rate of burning of time-fuses is influenced by the altitude at which they are burned, or, in other words, by the degree of pressure of the atmosphere, the combustion being proportionately slow with every decrement of pressure of the air. When the platinum-wire is first raised to a red heat in the centre of the tuft of gun-cotton, enclosed in a highly-rarefied atmosphere, the products resulting from the decomposition of that portion of the material which is in close contact with the wire, immediately distribute themselves through the rarefied space, conveying away and rendering latent by their great expansion the heat furnished by the platinum-wire and that which results from the chemical change. The increase of pressure within the confined space, by the generation of the gases and vapours, on the one hand, and, on the other hand, the effect of the heated gases, which escape, upon the particle of gun-cotton through which they permeate, result, in the course of time, in the ignition of the mass; but, even then, the gun-cotton burns only slowly, because, in consequence of the rapidity with which the resulting gases and vapours escape and expand, much of the heat essential for the maintenance of the combustion is at once conveyed away. The latter result is strikingly exemplified by the experiment in which gun-cotton-yarn is substituted for the tuft of carded gun-cotton; indeed, if the atmosphere be very highly rarefied (to 0·6 in inches of mercury), and a sufficient length of the gun-cotton-yarn (4 or 5 inches) be employed in the experiment, the burning of the material induced by the heated wire will proceed so slowly that the heat resulting from the chemical change will be conveyed away from the burning surface, by the gases generated, much more rapidly than it is developed; so that the gun-cotton will actually become extinguished when only a small portion of it has been burned.

A very similar result is obtained if gunpowder, either in the form of grains or of one large mass, is exposed to the action of an incandescent platinum wire imbedded in it, the pressure of the atmosphere in the apparatus in which the experiment is made being reduced to between 0·6 and 2 in inches of mercury. The portion of gunpowder contiguous to the heated wire will fuse, vapours of sulphur will be evolved in the first instance, and subsequently the charcoal will be oxidised by the nitre, bubbles of gas escaping from the fused mass. The vapours and gases thus generated convey away rapidly the heat provided by the wire and developed by the chemical action; and, at the same time, the change which the gunpowder undergoes diminishes its explosive character, so that its partial ignition or explosion will only be effected after the lapse of several minutes, and, if it be in the form of grains, the explosion of the particles contiguous to the wire will have the effect of scattering the remainder without igniting it.

The great reduction in the rapidity of combustion of gun-cotton is not the only result observed when small quantities of that substance are exposed to heat under diminished atmospheric pressure. In the most highly rarefied atmospheres (from 0·5 to 1 inch) the only indication afforded of the burning of the gun-cotton is the appearance of a beautiful green glow, like a phosphorescence, immediately surrounding that part which is undergoing decomposition. When the pressure of the atmosphere is slightly increased, a faint yellow lambent flame appears beyond the green glow, at a short distance from the point of decomposition; and, in proportion as the atmosphere is less rarefied, this pale yellow flame increases in volume, while the green phosphorescence becomes less and less apparent until it seems to be completely obliterated. Lastly, when the pressure of the atmosphere is comparatively great (=25 or 26 in inches of mercury) the gun-cotton burns with the ordinary bright flame, though less rapidly, of course, than it does under normal conditions of atmospheric pressure. There is no doubt that this bright flame is due to an almost instantaneous secondary combustion (in the oxygen supplied by the air in the apparatus) of the inflammable gases evolved by the decomposition. On the other hand, the production of the small pale flame observed when gun-cotton is burned in more highly rarefied air, or in atmospheres of gases which cannot supply oxygen for combustion, is most probably due to the generation of a mixture of gases (by the change which gun-cotton undergoes under these conditions), which contains not only combustible bodies, such as carbonic oxide, but also a proportion of oxidising gases (protoxide of nitrogen, or even oxygen); such a mixture, having self-combustible properties, will receive sufficient heat from the burning gun-cotton to become ignited, except when the atmosphere in which the change takes place is so highly rarefied that the heat is immediately dissipated, and the gases evolved become highly attenuated, as already described.

It will be readily conceived that the mechanical state of the gun-cotton (*i.e.*, the particular form in which it is employed), like other variable conditions which have been alluded to, will greatly influence the nature of phenomena observed when this substance is ignited in air, or in various gases, either at ordinary or diminished pressures. This may be exemplified by the following experimental illustrations. It has been stated that, when a tuft of carded gun-cotton is ignited in carbonic acid, carbonic oxide, nitrogen, coal gas, hydrogen, and other gases, it burns only with a pale yellow flame; this flame, when furnished by equal quantities of gun-cotton, is much smaller in an atmosphere of hydrogen than it is, for example, in carbonic acid; a fact which must be ascribed to the comparatively very rapid diffusion of the generated gases when hydrogen is used. In operating with pieces of gun-cotton yarn, instead of employing loose tufts, the material, when ignited by a red-hot wire in atmospheres of carbonic acid, nitrogen in carbonic oxide, burns much more slowly than it does in air under the same conditions; and its combustion is accompanied only by a very small jet or pointed tongue of pale flame, which is thrown out in a line with the burning extremities of the piece of yarn. In the same way, if the yarn is enclosed in a tube or other vessel through which those gases are circulating, and from which one extremity of the gun-cotton protrudes, when the latter is lighted it will burn in the ordinary manner only until it reaches the opening of the tube, when the form of combustion will at once be changed to that just described. If, however, corresponding experiments are made in atmospheres of hydrogen or coal gas, the gun-cotton yarn will burn in the slow manner described, but only for a very brief period—indeed, it ceases to burn at all almost instantaneously, just as it does when ignited in a very highly rarefied atmosphere. This result is not due to the high diffusive powers of the gas in which the gun-cotton is burned, as it may be obtained equally in open and in perfectly closed vessels; it can, therefore, only be ascribed to the high cooling powers, by convection, of the gases employed. Pure nitrogen, as stated just now, allows the gun-cotton yarn to burn in the slow manner, but if mixed with one-fourth its volume of hydrogen it arrests the combustion of the material, just like coal gas or pure hydrogen.

(To be continued.)

ROYAL SOCIETY.

Thursday, May 26, 1864.

Professor W. A. Miller, *V.P., in the Chair.*

The following paper was read:—"*Note on the Variations of Density produced by Heat in Mineral Substances*," by Dr. T. L. Phipson, F.C.S.:—That any mineral substance, whether crystallised or not, should diminish in density by the action of heat might be looked upon as a natural consequence of dilation being produced in every case and becoming permanent. Such diminution of density occurs with idocrase, Labradorite, feldspar, quartz, amphibole, pyroxene, peridote, Samarskite, porcelain, and glass. But Gadolinite, zircons, and yellow obsidians augment in density from the same cause. This again may be explained by assuming that, under the influence of a powerful heat, these substances undergo some permanent molecular change. But in this note I have to show that this molecular change is not permanent, but intermittent, at least as regards the species I have examined, and probably with all the others. Such researches, while tending to elucidate certain points of chemical geology, may likewise add something to our present knowledge of the modes of action of heat. My experiments were undertaken to prove an interesting fact announced formerly by Magnus—namely, that specimens of idocrase after fusion had diminished considerably in density without undergoing any change of composition: before fusion their specific gravity ranged from 3·349 to 3·45, and after fusion only 2·93 to 2·945. Having lately received specimens of this and other minerals brought from Vesuvius in January last by my friend Henry Rutter, Esq., I determined upon repeating this experiment of Magnus. I found, first, that what he stated for idocrase and for a specimen of reddish-brown garnet was also the case with the whole family of garnets as well as for the minerals of the idocrase group; secondly, that it is not necessary to melt the minerals: it is sufficient that they should be heated to redness without fusion, in order to occasion this change of density; thirdly, that the diminished density thus produced by the action of a red heat is not a permanent state, but that the specimens, in the course of a month or less, resume their original specific gravities. These curious results were first obtained by me with a species of lime garnet in small yellowish crystals, exceedingly brilliant and resinous, almost granular, fusing with difficulty to a black enamel, accompanied with very little leucite and traces of grossular, and crystallised in the second system. Specimens weighing some grammes had their specific gravity taken with great care, and by the method described by me in the Chemical News for 1862. They were then perfectly dried and exposed for about a quarter of an hour to a bright red heat. When the whole substance of the specimen was observed to have attained this temperature, without a trace of fusion, it was allowed to cool, and when it had arrived at the temperature of the atmosphere, its specific gravity was again taken by the same method as before. The diminution of density being noted, the specimens were carefully dried, enveloped in several folds of filtering paper, and put aside in a box along with other minerals. In the course of a month it occurred to me that it would be interesting to take the specific gravity again, in order to ascertain whether it had not returned to its original figure, when, to my surprise, I found that each specimen had effectively increased in density and had attained its former specific gravity. Thus:—

Lime garnet mellitite (from Vesuvius).

Original density.	Density after being heated red-hot for a quarter of an hour and allowed to cool.	Density determined in a month after the experiments.
I. 3·345	2·978	3·344
II. 3·350	2·980	3·350
III. 3·349	2·977	3·345

The same experiments were made with several other minerals belonging to the idocrase and garnet family, and always with similar results. Now I ask, what becomes of the heat that seems to be thus shut up in a mineral substance for the space of a month? The substance of the mineral is dilated, the distance between its molecules is enlarged, but these molecules slowly approach each other again, and in the course of some weeks resume their original positions. What induces the change, or how does it happen that the original specific gravity is not acquired immediately the substance has cooled?[*] Will the same phenomenon show itself with other families of minerals or with the metallic elements? Such are the points which I propose to examine in the next place; in the mean time the observations I have just alluded to are proof that bodies can absorb a certain amount of heat not indicated by the thermometer (which becomes latent), and that this is effected without the body undergoing a change of state; secondly, that they slowly part with this heat again until they have acquired their original densities; thirdly, so many different substances being affected by a change of density when melted or simply heated to redness and allowed to cool, it is probable this property will be found to belong, more or less, to all substances without exception.

(To be continued.)

Royal Institution.—Monday, June 6, at two o'clock, General Monthly Meeting. Tuesday, June 7, at three o'clock, Professor Marshall, "On Animal Life." Thursday, June 9, at three o'clock, J. Hullah, Esq., "On Music (1600—1750)." Friday, June 10, at eight o'clock, Professor Tyndall, "A Magnetical Experiment." Saturday, June 11, at three o'clock, Alexander Herschel, Esq., "On Falling Stars and Meteorites."

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[*] Some minerals, like enclase, that become electric by heat, retain that state for a considerable time. The increase of density of Gadolinite and the decrease of density of Samarskite by action of heat, are accompanied by a vivid emission of light, as mentioned in my work on "Phosphorescence," &c., pp. 31 and 32, where H. Rose's ingenious experiment is described.

ACADEMY OF SCIENCES.

May 23.

THE great length to which our English reports extend this week obliges us to curtail our notice of the proceedings of the French Academy. This is of the less consequence, inasmuch as the memoirs and notes contributed at the last meeting are either of small interest or defy abridgment. The most important were contributions of physics by MM. Fizeau and Matteucci. The former was "*On the Dilatation and Double Refraction of Heated Rock Crystal*," and the latter "*On Electrical Earth Currents*." M. Boussingault gave another instalment of his memoir "*On Vegetation in Darkness*," to which we shall allude when the paper is concluded. The purely chemical papers included one by M. Wurtz "*On the Oxidation of the Hydrate of Amylene, and Isomerism in Alcohols*;" one by M. Reboul "*On the Bromides and Hydrobromates of Valerylene*;" and by Berthelot "*On the Action of Iodine and Hydriodic Acid on Acetylene*." These papers will shortly receive more extended notice. One other deserves attention—viz., that by M. Marigny, "*On the Artificial Formation of Galena and Copper Pyrites*," to which the author added some speculations "*On the Formation of Metalliferous Veins*."

NOTICES OF BOOKS.

Chemistry for Photographers: Le Preparateur-Photographe ou Traité de Chemie a l'Usage des Photographes, &c., &c. Par le Dr. T. L. PHIPSON, &c., &c. Paris: Leiber. 1864.

AN Englishman who produces a scientific work in a foreign language challenges a double criticism from the nation whose language he writes. Both his linguistic and scientific pretensions will be severely examined, and woe betide the adventurous author who fails to establish his reputation in either.

What a Frenchman will say to Dr. Phipson's French it would be hard for us to say. All we know is, that it is French which an Englishman can easily read, and that is no small merit in our estimation. Some one has said the same thing of the French of Pascal and Bossuet, which the author of this book may lay to heart if a modern writer should quarrel with his diction.

What the Frenchmen may say to the matter of the work it is not so difficult to tell. At the beginning, in a table of the simple bodies, the author gives symbols, some of which have long been discontinued, and others which we do not think were ever in use among French chemists. For example, the symbol of arsenic he writes Ar.; that of cœsium, Cœ.; chromium, Ch.; iodine, Io.; thallium, Th.; thorium, To. In the same table, too, there are obvious blunders in the names of the elements, but these we may suppose to be vagaries of the printer.

The first part of Dr. Phipson's book consists of a succinct statement of the general principles of chemistry. The Section concludes with a chapter on "the way to study chemistry," the first sentence of which we may seriously recommend to the attention of every student who wishes to advance the science. "Comme pour tout science, il faut, pour etudier convenablement la chemie, procéder le plus possible du connu a l'inconnu."

The author next proceeds with an account of the metalloids; and in the account of oxygen we note an omission, and meet with a passage which will perhaps bring the French critics down upon him. He tells his readers that the best way to obtain oxygen in the laboratory is to heat chlorate of potash over a spirit-lamp. Now, most people know that oxygen is to be procured much more easily from a mixture of chlorate of potash and binoxide of manganese. It is, in fact, so stated in all the French elementary works on chemistry we have met with. But, desirous of making a little capital for an Englishman, the author, after a reference to Deville's method of getting oxygen from sulphuric acid (in which, by the way, is a gross misprint), writes as follows:—

"More recently Mr. Matthey, of London, has decomposed in one operation twenty-two kilogrammes of chlorate of potash, mixed with an equal weight of peroxide of manganese. This mixture decomposes much more easily than the chlorate by itself."

There is much more, we fear, in the book with which Frenchmen may quarrel, and we must leave Dr. Phipson to the national criticism he challenges. Our duty is done when we have announced the publication of the work.

The Condensed Argument for the Legislative Prohibition of the Liquor Traffic. By Dr. F. R. LEES. London: Caudwell, Strand. 1864.

THIS work appears to have been sent to us not for review, but to obtain an opinion in favour of what is called the "Permissive Bill" of the United Kingdom Temperance Alliance. We can have no hesitation in expressing such an opinion, and should be very glad to see the bill pass, although we have many doubts whether it would not rather increase than diminish drunkenness. Into the argument we cannot enter, but of the book it is impossible to speak too highly.

NOTICES OF PATENTS.

RELATING TO THE PRODUCTION OF COAL-TAR COLOURS.

92. *Manufacturing Magenta Colour or Dye.* D. DAWSON, Huddersfield. Dated January 12, 1863.

THE patentee first produces the neutral arseniate of aniline by mixing together, in equivalent proportions, aniline and an aqueous solution of arsenic acid. This latter ingredient should contain from 23 to 30 per cent. of water, including the water of hydration. Such a solution is liable to deposit a certain quantity of the arsenic acid in the form of crystals, but these need not be separated, inasmuch as they will become dissolved and enter into combination with the aniline so soon as the mixture is heated. The arseniate of aniline is described as a solid substance, usually white, and having a somewhat crystalline aspect. At this stage the saline substance retains all the water originally present in the arsenical solution, and probably in the condition of water of crystallisation. The patentee next submits this product, in a strong iron cylinder or other appropriate apparatus, to a temperature varying between 345 and 360 degrees Fahrenheit, and under a pressure of 70 to 100 lbs. on the square inch. The heat is usually required to be maintained for a period of about twelve hours, but the interval of time must be regulated by the weight of material used in the operation and by the size of the apparatus. The result of this treatment is a red compound, which, after purification by well-known methods and subsequent solution, furnishes the magenta dye.

Pending the judicial settlement of the question at issue, it is only necessary to mention the circumstance that the main point of difference between this and Dr. Medlock's earlier claim is based upon the proportion of water contained in the materials used in the manufacture of this colouring matter.

117. *Manufacturing Colours for Dyeing and Printing.* J. A. SCHLUMBERGER, Basle, Switzerland. A communication. Dated January 14, 1863.

FOR the purpose of obtaining a pure blue colouring matter, which is particularly applicable to the dyeing of silk and woollen fabrics to be worn by night, the inventor transforms the ordinary red magenta salt into a compound which may be used as a blue dye when dissolved in alcohol or methylated spirit. The mode of proceeding is to mix with the hydrochlorate or other salt of rosaniline a suitable proportion (generally three parts) of the acetate of aniline, toluidine, or other homologous base, then to add an amount of carbonate of soda, or any alkali, for the purpose of liberating the organic bases. The mixture so obtained is then heated to a temperature which may vary between the limits of 180 and 210 degrees Centigrade, until on testing a portion the desired tint has been attained. The product is next boiled with hydrochloric acid and with water, in order to remove from it traces of purple or red compounds which are apt to survive the operation of conversion.

The details of this process, both as regards the system of production and the method of purification, are very similar to those described by Girard for effecting the same purpose.

138. *The Manufacture of Colouring Matters.* C. H. Greville Williams. Dated January 15, 1863. (Not proceeded with.)

271. *Red Colouring Matter.* C. H. Greville Williams. Dated January 29, 1863.

These specifications refer to the employment of the acetate or phosphate of mercury for the purpose of forming red colouring matters with aniline or one of its homologues, or any salt of these bases, particularly the acetate, sulphate, nitrate, or hydrochlorate of aniline. The patentee prefers to use the materials in the proportion of two equivalents of aniline to one equivalent of the mercury salt. A mixture of the salts of aniline and toluidine may be employed, and, in addition, a certain quantity of uncombined aniline; these ingredients are heated together with the mercury salt until the desired colour is produced, and the product is dissolved in the usual manner for the purposes of the dyer.

The employment of a mercury salt in the preparation of magenta dye has hitherto introduced a difficulty in the purification of the product. There is no doubt that a considerable variation in the tint of the resulting colour is under the inventor's control.

151. *Printing and Dyeing Textile Fabrics and Yarns.* J. Lightfoot. Dated January 17, 1893.

The inventor describes the use of several metallic oxides and salts which may be associated as mordants with certain compounds of aniline or homologous bases for the purpose of producing a black dye on yarns or textile fabrics.

192. *Obtaining Colouring Matters.* H. Caro and J. Dale, Manchester. Dated January 21, 1863.

The patentees treat the red and purple coal-tar colours with acroleine, when, under the influence of heat, they become modified in tint. Likewise, they obtain a blue colouring matter by the action of aniline and benzoic acid upon mauve and purple dyes.

The result of the second process does not appear to be sensibly different from that produced by the action of aniline alone, which is well known to have the power, when assisted by heat, of modifying the colour of the red and purple dyes to the extent of changing them to blue.

Communicated by Mr. Vaughan, Patent Agent, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1191. Thomas Walker, Birmingham, Warwick, "Improvements in means or apparatus for the utilisation of sewage matters, part of which improvements is applicable to raising and forcing other fluids. Petition recorded May 11, 1864.

1092. Frederick Leisz, New Coventry Street, Leicester Square, "Improvements in the manufacture of syrups."—A communication from Jean Jaques Grosheinz and Auguste Sheurer, Logelbach, near Colmar, Haut Rhin.—Petition recorded April 30, 1864.

1113. Peter Ward, Cloud's Hill Villas, St. George's, Bristol, "Improvements in lubricating compounds."—Petition recorded May 3, 1864.

1124. John Potter, Manchester, "A new compound or composition for artificial stone, and for certain machinery or apparatus to be used in mixing and applying the said composition."—Petition recorded May 4, 1864.

1136. Edward Beanes, Argyll Street, Middlesex, and Conrad William Finzel, Bristol, "Improvements in sugar boiling."

1138. Alfred Vincent Newton, Chancery Lane, Middlesex, "Improvements in the means of, and apparatus for, generating heat."—A communication from Albert Borsig, Edward Freudenthal, and Alexander Daelen, Berlin, Prussia.—Petitions recorded May 5, 1864.

1156. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in apparatus for economising the consumption of gas."—A communication from Ernest Jonrdan, Paris, France.

1166. Henry Woodward, Euston Road, Middlesex, "Improvements in apparatus for carburetting gas."—Petitions recorded May 7, 1864.

1172. Henry Aitken, Falkirk, N.B., "Improvements in the system or mode of calcining and extracting the oils and gases from ironstone and other materials, and in the apparatus or means employed therefor."

1174. Don Francisco Marques Millau del Real, Rue Mantree, Bordeaux, France, "Improvements in extracting silver from lead."

1178. Alfred Vincent Newton, Chancery Lane, Middlesex, "Improved apparatus applicable to the heating and evaporating of fluids."—A communication from Leopold Wiart, Cambrai, France.—Petitions recorded May 9, 1864.

1181. James Alfred Wanklyn, Finsbury Circus, "The manufacture of purple dye stuffs from manna sugar."

1188. David Jones and Bryan I'Anson, Birmingham, Warwick, "Improvements in casks or other vessels for the storing and preservation of wines, spirits, and other liquors or fluids, and for facilitating the drawing off of the same." Petitions recorded May 10, 1864.

1192. James Brown, Aldgate, London, and Astley Paston Price, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of blotting paper."

1196. Thomas Matthew Gisborne, Lymington, Southampton, "Improvements in kilns for burning bricks, tiles, and other earthenware or ceramic articles, limestone, and ores."—Petitions recorded May 11, 1864.

1203. William Horne, West Ham, Essex, "Improved methods of treating canvas, tarpaulings, or other painted canvas, to render them suitable for household and other useful purposes."—Petition recorded May 12, 1864.

1211. Edward Myers, Millbank Row, Westminster, and Thomas Guy Progers, Cambridge Street, Pimlico, "Improvements in wet gas meters."—Petition recorded May 13, 1864.

1243. Richard Archibald Brooman, Fleet Street, London, "Improvements in dyeing wool and other filamentous and textile materials, and in machinery employed therein."—A communication from Jean Henri Claudet, Rouen, France.—Petition recorded May 17, 1864.

Notices to Proceed.

112. Alfred Field Henery, Dorset Street, Manchester Square, Middlesex, "An improved galvanic belt."—Petition recorded January 15, 1864.

131. Carl Vogt, Cassel, Electorate of Hesse, "Improvements in the manufacture of pigments."—A communication from Ludwig Schad, Cassel, aforesaid.—Petition recorded January 18, 1864.

152. Thomas Lightfoot, Accrington, Lancashire, George

Powell Barnes, Manchester, Lancashire, and John Lightfoot, of Accrington, "Improvements in fixing colours on woven fabrics or fibrous materials."—Petition recorded January 20, 1864.

163. Edgar Townend Jarrold, Norwich, Norfolk, and George John Yates, Penketh, near Warrington, Lancashire, "Improvements in deodorising paraffine, petroleum, rock shale, and other hydrocarbon oils."—Petition recorded January 21, 1864.

390. Henry Walker Wood, Blackweir, Glamorgan, "Improvements in cylinders exposed to the direct action of fire, and employed in the manufacture of artificial fuel, and in heating and drying other substances."—Petition recorded February 15, 1864.

627. Robert Hanham Collyer, Alpha Road, St. John's Wood, Middlesex, "An improved apparatus and process for the conversion of substances into material for the manufacture of paper and textile purposes."—Petition recorded March 12, 1864.

990. Alexander Colvin Fraser, Loughborough, Leicestershire, "Improvements in apparatus used in the manufacture of gas."—Petition recorded March 20, 1864.

1081. Richard Archibald Brooman, Fleet Street, London, "A new method of treating wood and other ligneous substances in order to produce alcohol and to obtain the cellular tissue or fibre from such substances, applicable to the manufacture of paper and other uses."—A communication from François Marie Bachet and Etienne Machard, Annecy, France.

1087. Frank Clarke Hills, Deptford, Kent, "Improvements in, and applicable to, furnaces to be used in the manufacture of gas."

1088. Frank Clarke Hills, Deptford, Kent, "Improvements in the purification of gas, and in obtaining a valuable product in the process, and for the preparation of some of the materials to be used in the said purification."—Petitions recorded April 29, 1864.

MISCELLANEOUS.

YOUNG *v.* FERNIE.

(Continued from page 264.)

Dr. Lyon Playfair, examined by Mr. Grove. In the first part of his evidence, Dr. Playfair was taken over the same ground as Dr. Hofmann in his re-examination by Mr. Bovill, and gave substantially the same replies. On coming to De Hompesch's patent, the witness said he had made experiments on two kinds of coal, boghead and leeswood, both cannel coals. The first experiment was to ascertain the effect of a heat of 600°; for that purpose, he said, I took lead at its point of fusion. I placed boghead coal under melted lead for several hours, and when I took it out the coal was unchanged, a little water only had left it. There was a faint empyreumatic smell. I placed leeswood coal in the same bath for half-an-hour. Desiring a more constant temperature (for you cannot keep it exact with lead), I subjected the two coals to the heat of boiling mercury, which is quite precise, 662°. I found at this temperature, at which the water came freely off, a distinct empyreumatic smell; and on the watery distillate, I saw with a magnifying glass solid crystals, which I presumed to be paraffine, but they were too small to examine. The total loss of weight, including the water, was 4 per cent., and the whole product was miscible with new water, showing that no oil was produced. I then put my retorts into a temperature at which zinc just melts—773°. At that temperature more water came off, and now some drops of oil, but not enough to escape from the neck of the retort. I now heated up the sand-bath until it became faintly luminous in the dark, and at this temperature boghead gave 30 per cent. and leeswood 23 per cent. of crude oil. The crude oil of course contained a little water. The temperature was a low red heat—980° according to Miller's tables. I did not define it; it would require a scientific investigation by myself to do so. The result of these experiments is that there is no practical distillation up to 773°. I tried carefully to get a heat between 773° and a low red, but did not succeed. The lowest temperature at which a practical distillation can take place is between 800° and 1000°; I cannot say nearer. In both the experiments mentioned the oil obtained was saturated with paraffine, and became semi-solid on standing. There is nothing in Lord Dundonald's patent to indicate Mr. Young's process; nor in Reichenbach's papers to indicate the process in a commercial sense. I never saw paraffine which was obtained from coal until after Mr. Young's patent, nor do I recollect seeing it from schist.

Cross-examined by Sir Fitzroy Kelly: Before the date of Young's patent it was knewn that oil could be obtained from bituminous coal by distillation, and that the oil contained paraffine. It was known also that more oil was obtained at a low temperature, and gas and naphthaline beyond a red heat. It was known at the date of the patent that an oil could be produced from coal, but it was not known, to my knowledge, that it contained paraffine oil. It was known that the oil contained paraffine, but paraffine oil is a distinct substance—paraffine which is permanently in a liquid state. Reichenbach's product was tar mixed with a small quantity of paraffine; Mr. Young's paraffine oil not containing tar. In the description of Genssane's process in Morand's work the words "slightly red" may be read a "low red heat." This description of the heat does not substantially differ from that in Mr. Young's specification. The product which passed into Genssane's receiver was a bitumen used for burning and for greasing cart wheels. I do not believe it was the same as Mr. Young's crude oil. I believe it was tar containing a good deal of paraffine. The oil passed off by the vertical pipe near the retort, intended to carry off what Genssane calls "sulphur." That "sulphur" I believe to have been chiefly the volatile products. The difference in the products I ascribe to the difference in the condensing apparatus. If Mr. Young's present apparatus had been adopted there would have been a large proportion of Mr. Young's crude oil. I called Genssane's product tar. Tar is used as an oil for burning in miners' lamps, but it is a very smoky oil. Undoubtedly it was a novelty to obtain an oil containing paraffine from bituminous coals. If Mr. Young had said a tar containing paraffine, there would have been nothing absolutely new. When he uses the term an oil containing paraffine, he indicates a liquid paraffine in which paraffine was in solution, and to the best of my knowledge that was new, both as a discovery in the arts, and as a discovery, so far as I know, not formerly described in science. It was not new to obtain tar containing paraffine; but it was new, in my estimation, to obtain an oil, in the sense in which Mr. Young uses it, containing paraffine. I have said before that it was not new to obtain an oil containing paraffine from bituminous coals. I showed Mr. Young's oil at the Royal Institution in 1852; it was "paraffine oil." I do not think the crude oil was ever burnt in lamps. There are three, perhaps four, substances made from the crude oil; first, naphtha, which is not used for burning, but only for purposes like turpentine; next, the portion which is used for burning; thirdly, the lubricating oil; and, lastly, paraffine. The burning oil is obtained after you have taken away the most volatile portions. [The witness was then examined on the processes of Lord Dundonald, De Hompesch, and Du Buisson, but this part of the examination offers nothing of importance, nor was anything of interest elicited in the re-examination by Mr. Grove.]

Sir Robert Kane (examined by Mr. Hindmarsh): The evidence of this witness was simply a confirmation of that of the two previous witnesses. In the cross-examination by Sir Fitzroy Kelly witness expressed an opinion that the original idea of Mr. Young's patent might be traced in a vague and misty way in Genssane's process, but the products of the process conducted according to Genssane's own directions would have no practical similarity to Mr. Young's, nor any commercial value for the same purposes.

The next witness examined was the plaintiff, Mr. J. Young, who in his evidence gave an account of the experiments which led to his taking out the patent in dispute. Subsequently the witness described his recent improvement of conducting the distillation in a vertical iron retort, cased in brick about a third of the way up, which is charged at the top, and the coke raked out at the bottom. The coals pass through this in three hours. A specimen of pure paraffine weighing about 60 lbs. was produced, and the witness said it would take about two tons and a half of coal to produce that quantity. One ton of coals will produce over 100 gallons of crude oil; about one-third of which will be lost in refining. The paraffine is separated from the oil partly refined; it crystallises out and is separated by straining. Pure paraffine fetches one shilling a pound; and the refined oil is sold for 2s. 3d. a gallon.

Mr. Young was then cross-examined by Mr. Mackeson. In the course of the cross-examination, extracts from Nicholson's "Dictionary of Chemistry," 1795, and Macquer's "Dictionary of Chemistry," 1777, were produced, which showed that coal had at that time been submitted to distillation, and oils and petroleum obtained therefrom. The witness was then examined as to the resemblance of the apparatus he uses with that used by Reichenbach, who also used an iron retort cased in brick at the sides, so that the fire could only reach the retort at a part covered with coal. Reichenbach also adopted the precaution of applying the heat gradually up to a dull redness to avoid the production of napthaline. With regard to the nature of the coals employed, Mr. Young admitted that other besides Boghead coal was employed by him. A cannel coal from Wigan yielded the oils. At first 15s. 6d. per ton was paid for boghead; it has since sold for 45s.

Drs. Stenhouse and Odling were called to prove the identity of the defendant's oils with those of the plaintiff. The other witnesses were mining agents and geologists, whose evidence we need not notice. In our next we shall give the shortest possible statement of the case for the defendants, which will, however, be well understood from the Vice-Chancellor's judgment, which follows:—

JUDGMENT.

The Vice-Chancellor: The main objection to the validity of the plaintiff's patent is, that both as to the process and material there is nothing new; and that the specification indicates nothing which was not publicly known and publicly used before the date of the patent.

It appears, from the evidence, that for very many years before the discovery of the substances now called paraffine and paraffine oils, the distillation of coals and bituminous substances, at every variety of temperature, had been well known and practised for the production of tars and oils which had been used for lubrication of the ruder kinds of machinery and for burning. It is certain that the discoveries by Reichenbach of paraffine, naphthaline, and various other distinct substances, as products from the carbonisation of animal tar, vegetable tar, and coal tar, about the year 1832, were hailed by men of science as important discoveries. In one passage of his writings, as printed in the Extracts before the Court, Reichenbach says:—"There must necessarily be several ways and means of getting at a body of so strong a constitution as paraffine, when mixed up with others so easily decomposed as those which we will for the present consider under the collective denomination of empyreumatic oils. I have come upon the track of some of these; others, perhaps better ones, the future will discover."

It is certain that Reichenbach, although he ascertained the existence of paraffine in coal, did not indicate coal of any kind as the material capable of producing paraffine or paraffine oils in most abundance. There is ample evidence that the attention of practical chemists was previously to the date of Young's patent laboriously directed to discover the proper material and the proper means of producing these articles in sufficiently large quantities for commercial purposes. Amongst others, Hompesch's patent was obtained in 1841 for obtaining oils from schist or clay slate and asphalte; and his memorandum of alteration is made for the purpose of confining it to "other rocks or minerals containing bitumen or bituminous substances." Du Buisson's patent, granted in 1845, is remarkable for its recital that in England all attempts to make bituminous schistus useful had failed. His specification claims a particular apparatus and process, and it states that the presence of paraffine is scarcely perceptible in bituminous stone, asphalte, or other bituminous mineral substances, and that it is in schistus that it is contained in the largest proportion.

There is no evidence of any specification, of any patent, or any publication in which cannel coal, or coal which produces olefiant and other highly illuminating gases in considerable quantity, was indicated as the class of materials, among the wide range of animal, vegetable, and mineral substances, which, subjected to a proper process, would produce paraffine and the oils called by Young paraffine oils in large quantities, so as to create a manufacture for commercial purposes, till Young's specification was published. Cannel coals had been tried by many, but without success. Among the many practical and manufacturing chemists who had been vainly attempting to find out how to manufacture paraffine oils and paraffine so as to supply the market, none had been fortunate. The fair result of the immense load of evidence in this case shows the prevailing opinion to have been, that not coals of any kind, but shales or schists properly so called, were the best material. The witnesses of the defendants give evidence which seems convincing on this subject.

Mr. Kirkham, a practical and manufacturing chemist, has proved that from the year 1845 he had been making experiments on what he calls crude oil, and the distillation of various kinds of coals, including cannel coals, at a temperature of something like 700 degrees of Fahrenheit, for the purpose of ascertaining what oil they would produce; but that he could not succeed in getting quantities of oil from these various kinds of coal of any commercial value, although he distilled in large quantities. The results he obtained from cannel coals he found little better than from Newcastle coals. This witness who states these facts states also with perfect confidence that there is nothing new in Young's specification, and nothing described in it which he did not know before. This statement is true in this sense, that it was well known that coals, cannel coals, as well as every other animal, vegetable, or mineral production, could be distilled at any temperature within a very wide range, and would produce paraffine and paraffine oils. But it is not true, in this sense, that he knew before he read Young's specification, which class of substances, among many, and which temperature in a wide range, and which process, among many, would supply the commercial world and the public with a class of paraffine and paraffine oils which so many were in vain seeking to supply, till the manufacture of Young had supplied it. From the evidence of this witness and the evidence of Fisher, a practical and manufacturing chemist, and the evidence of Parkes, a very intelligent witness, it appears, when accurately weighed, that these persons, like many others, were unsuccessfully attempting to manufacture paraffine oils and paraffine for commercial purposes. Fisher, in particular, seems to have been working for years extensively to produce paraffine oils of a quality to supply the market. He distilled shales and coals of various kinds, including boghead itself, in considerable quantities. He states that he was largely engaged in the manure trade, and has had by him as many as 1000 or 2000 gallons of oils, produced, as he says, from "coals, shales, cannels, and different things." He supplied the other witness, Parkes, with oils, out of which he extracted paraffine; and, according to Parkes' statement, the total amount supplied to him at various times during several years was not less than 100 gallons altogether.

Parkes also was engaged in experiments as to the production of burning oils and paraffine from shales and coals, with a view to perfect a manufacture, for which, if he could have succeeded, he says he wished to obtain a patent. Experimentally he had gone so far as to produce small pieces of candle and night lights. This witness, who seems an intelligent person, employed Fisher, and gave him instructions and suggestions as to the distillation of shales, and coals, and cannels for the production of paraffine oils. But it is needless to go farther than this evidence produced by the defendants of these three persons, Kirkham, Fisher, and Parkes, the most important practical witnesses of the defendants, for clear proof that they, like so many others, were laboriously endeavouring to effect, and entirely failed in effecting, the discovery made by Young. They did not discover that cannel coals and other coals which yield olefiant and other highly illuminating gases were the proper material.

The completeness of the failure is demonstrated by two facts—first, that the oils sent by Mr. Fisher to the Great Exhibition of 1851 were rejected and refused a place on account of their objectionable quality and offensive smell; and second, that after Young's patent, in Fisher's correspondence with a person named Clift, it is stated by the latter that Young could not make the oil so good from coals, and would direct his attention to the native bitumens; and a question is asked as to whether Fisher would work his retort beyond a cherry red.

This correspondence is in May 1851, and it affords ample evidence that the material, and the process, and the temperature indicated by Young were not those used or practised by them.

Each of these three witnesses, like most of the others for the defendants, says that Young's specification contains nothing new. No doubt this is true in the sense which I have already distinguished. But it is not true in the sense in which the law requires that the word "new" should be used and understood on the question to be decided in this cause. Mr. Parkes states that he was asked by Mr. Fisher to go to Scotland as a witness against the plaintiff Young, in an action in which the validity of the patent was contested on grounds similar to the most material in the present case; but he declined to go, for this good reason, that he considered Young ought to succeed as the first public introducer of the manufacture.

Turning now to the men of science who have supported the defendants' case by their testimony: Dr. Alfred Swaine Taylor stated that the amount of olefiant gas is no criterion of the quantity of paraffine that any particular coal will yield. But in his cross-examination he admitted that he did not examine the quantity of olefiant gas in the coals, and that he had made no experiments as to whether coals yield olefiant gas in the same ratio as paraffine. He admits that he was not aware before Young's patent that paraffine could be extracted from coal in merchantable quantities. He says that, although he knew paraffine was extracted from coal, yet Young's patent process came upon him as a novelty, and that it was a new thing to hear of it in the quantity which Young produced.

Dr. Anderson, who is another of the defendants' important scientific witnesses, is remarkable for his change of opinion on the question of novelty. He was one of the witnesses for Mr. Young in the Scotch cause. His report made with reference to that case is at variance with his evidence now given. He has stated the cause of his conversion to be the knowledge he had since acquired by what he had read of Selligue's works, and in the specification of Happey's patent, and in Black's "Elements of Chemistry." When these writings are looked at, his reasons and explanations as to his change of opinion appear to be so very lame that the value of his evidence is reduced to a low degree.

He and the other scientific witnesses, together with workmen and others who gave evidence, and a narrative of experiments on the questions of temperature and materials, seem to me to have afforded no real assistance to the defendants' case.

Experiments conducted for the express purpose o manufacturing evidence for this cause are to be looked at with distrust.

As to the many witnesses produced to prove that boghead coal is a "shale;" that all cannel coals are shales; that Kimmeridge shale is coal; that Leeswood curly cannel coal is not a shale, although other cannel coals are shales; that the manufacture of offensive and unmarketable oils from Kimmeridge shales was a manufacture of Young's oils and an anticipation of his invention; that the tar and coke ovens used in South Wales to produce a coarse tarry oil, used for lubricating the wheels of tram-waggons, was an anticipation of Young's lubricating paraffine oils; all the immense mass of evidence which the defendants have laid before the Court on these various points failed to produce any serious effect upon my mind towards establishing the case of the defendants, and a reconsideration of it satisfies me of its unimportance.

On the question of temperature, as described in Young's specification, there has been in the evidence and arguments on behalf of the defendants some confusion between the heat applied to the outside of the retort and the heat of the materials within. There has been a great conflict of evidence, but the result of a careful review and estimate of the evidence leaves my mind satisfied that Young's specification has given the proper directions and described the proper gradation and limit of the temperature, up to, and not exceeding, a low red heat on the outside of the retort, for producing paraffine oils and paraffine in the greatest abundance which has yet been obtained.

On the question of infringement, as well as with reference to the validity of the patent, the defendants have laboured to show by evidence that a temperature lower than a low red heat, and therefore not according to Young's specification, is that at which they have worked, and is the best temperature for producing paraffine oils and paraffine in the greatest quantity and of the best quality. Their evidence has entirely failed to establish the fact that they have not used for their manufacture the same class of coals, and the same gradation and limit of temperature which Young describes; or that a gradation and limit of temperature lower than Young's is the best. The evidence remains unshaken on this point, and on the other main points of the case the evidence of the plaintiffs' witnesses has been clear and strong, and greatly outweighs that of the defendants.

In dealing with the case it has seemed to me better to direct attention to what has been said by the witnesses of the defendants.

One of these, Dr. Taylor, admitted that there are many chemical substances produced, not in abundance, but in small quantities, which, if they could be produced in large quantities, so as to be merchantable commodities, would be highly valuable. This is the proposition which seems to be at the root of the plaintiffs' case. In the case of monopolies, Lord Coke says that all monopoly patents were void both by common law and the statute, unless they were granted to the introducer of a new trade or engine. The words of the statute of James the First are, "the sole working or vending of any manner of new manufactures within this realm to the true and first inventor and inventors of such manufactures."

Mr. Fernie, one of the defendants, has adduced in evidence a passage from the work of an eminent American chemist, Dr. Antisell, who holds an important position in the Patent Office of the United States of America. It appears that the plaintiff Young has obtained a patent in the United States for his manufacture. This book contains a short history of the manufacture of paraffine oils and paraffine; and it gives the following extract from a publication by Reichenbach in 1854:—"So remained paraffine until this hour a beautiful item in the collection of chemical preparations, but it has never escaped from the rooms of the scientific man." Something, therefore, remained to be ascertained, in order to the useful application of this article for economical and commercial purposes. This illustrates the important distinction between the discoveries of the merely scientific chemist and of the practical manufacturer who invents the means of producing in abundance, suitable for economical and commercial purposes, that which previously existed as a beautiful item in the cabinets of men of science.

What the law looks to is the inventor and discoverer who finds out and introduces a manufacture which supplies the market for useful and economical purposes with an article which was previously little more than the ornament of a museum.

It has been established to my satisfaction, by the evidence in this cause, that the plaintiff Young is an inventor of this class, and that his patent is entitled to the protection of the law. I find that he has ascertained, by a course of laborious experiments, a particular class of materials among many, and a particular process among many, which has enabled him to create and introduce to the public a useful manufacture, which amply supplies the market with that which, until the use of the materials, and process, and temperature indicated by him, had never been supplied for commercial purposes. At the date of his patent something remained to be ascertained which was necessary for the useful application of the chemical discovery of paraffine and paraffine oils. This brings it within the principle stated by the Lord Chancellor in the late case of "Hill *v.* Evans. The manufacture, with the materials and process indicated by him, according to the sense in which I understand the word "manufacture" to be used in the statute, was a new manufacture, not in use at the date of his patent.

The principle upon which the present case should be decided is, to my mind, so clear, that it is unnecessary to examine the cases cited by the defendants' counsel. Inventions in mechanics are as widely different from inventions in economical chemistry as the laws and operations of mechanical forces differ from the laws of chemical affinities, and the results of analysis and experiment in the comparatively infant science of chemistry, with its boundless field of undiscovered laws and undiscovered substances. This observation, as applied to reported cases, will strike the mind of every lawyer who has even a slight elementary knowledge of both sciences. But if it had been necessary to examine the authorities, there are to be found in them some propositions as to what amounts to a publication, and whether the use of a lock of peculiar and improved construction upon a gate is notice to the public of the nature of the improvement, which would, perhaps, deserve serious consideration. It is not, I think, the habit of mankind to go about examining the construction of the locks on their neighbours' doors or gates. Even the few men endowed with an honest curiosity in examining mechanical inventions would probably not be anxious to be found taking models of their neighbours' locks, or prying into the exact construction of fastenings intended to protect private property against the whole body of the public.

But whatever may be the correct view of the law on that subject, the principle which seems to me to govern the present case is broad and clear. Twice already has the validity of this patent been established before tribunals of high authority. First, before the Lord Chief Justice of England and an English jury; next, before the Lord President of the Court of Session in Scotland and a Scotch jury. All the most important parts of the evidence before me were laid before these tribunals. I recognise in the Lord President's charge to the jury a just view of the law. If my own mind had not been well satisfied upon it, I should have hesitated long before I ventured to dissent from these two decisions.

The conclusion is, that I find in favour of the plaintiffs upon all the four issues, and there must be a decree in favour of the plaintiffs, with costs to be taxed and paid by the defendants.

Fatal Explosion of Gun-cotton.—We regret to have to announce that a serious explosion occurred last week at the gun-cotton manufactory of Messrs. Prentice and Co., Stowmarket, Suffolk, which has resulted in the death of one of the female employées, and placed in jeopardy the lives of four other persons, including the foreman of the works. The coroner's jury have been unable to determine the precise cause of the disaster, and recommend the immediate appointment of a scientific commission to inquire into all the circumstances, with a view to prevent the recurrence of similar accidents. It is known that the operation of cutting the gun-cable into short lengths of about six inches, by means of a steel blade worked by machinery, was the primary cause of danger in this instance, and it is supposed that some particles of a gritty nature accidentally coming in contact with the knife had developed sparks or a sufficient degree of heat to ignite some portion of the material, and that the flame quickly spread to the whole cable (about ten feet in length) which was at the moment lying exposed in the immediate vicinity of the cutting machine.

ANSWERS TO CORRESPONDENTS.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 6d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

W. L. C.—See the *Comptes Rendus* of the date mentioned. The translation will appear in a week or two.

T. N.—The writer is anxious to acquire chemical instruction, particularly of a technical kind, by corresponding with any one who will aid him.

G. J.—1. In the War Department and at the Mint. 2. Through the heads of the departments.

N. J.—Carbonate of lead is soluble in nitric acid, sulphate of baryta is not.

Silicium.—On the large scale it is made on the hearth of the reverberatory furnace. Various kinds of sand are used, but oftener than either, flints first made red hot, then quenched with cold water, and afterwards ground to powder.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Classification of the Elements in Relation to their Atomicities, by Professor A. W. WILLIAMSON, *F.R.S., President of the Chemical Society.*[*]

THE object of Professor Williamson's paper was to show the chemical reasons for considering that the atomic weights of all the metals should be doubled, except the alkali metals, gold, silver, boron, and the metals of the nitrogen series. Cannizzaro argued some years ago in favour of this conclusion from a consideration that the atomic heat of these metals is just about half as great as that of gold, silver, antimony, phosphorus, &c. He proposed to remove the discrepancy by doubling the atomic weights of the heavy metals, the metals of the alkaline earths, &c., so that the product of the atomic weight with the specific heat of each of them should be equal to the product of the atomic weight of potassium by its specific heat, or of silver or antimony, &c. The chemical reasons for this change were argued to be of precisely the same kind as those which had already decided chemists to adopt for oxygen the atomic weight 16, and for carbon the atomic weight 12. The question, however, involves a general classification of the elementary bodies.

The author gave an outline of the analogies which connect chlorine, bromine, and iodine, equality of vapour-volume in the free state, the molecule of each of these elements containing two atoms in the same volume as that occupied by H_2, now generally called two volumes; the analogy of their oxygen compounds, the mono-basic character of the hydrides, the isomorphism of many of their corresponding salts, &c.

Very similar considerations are admitted to prove that oxygen, sulphur, selenium, and tellurium are analogous to one another in their general chemical properties and in the constitution of their similar compounds.

But each atom of oxygen, sulphur, &c., combines with two atoms of hydrogen, and is equivalent to two atoms of chlorine or bromine, &c., for if two volumes of steam, H_2O, or of alcohol vapour,

$$H(C_2H_5)O + PCl_5 = HCl + (C_2H_5)Cl + POCl_3.$$

When chlorine acts on hydrogen compounds it takes out one, two, or three hydrogen atoms, putting in an equal number of atoms of chlorine, thus:—

$$\underset{\text{Acetic acid.}}{C_2H_4O_2} + Cl_2 = \underset{\text{Chlor-acetic acid.}}{C_2H_3ClO_2} + HCl,$$

Whereas when oxygen re-acts on a hydrogen compound it takes out two atoms of hydrogen, replacing them by one of oxygen—

$$\underset{\text{Alcohol.}}{C_2H_6O} + O_2 = \underset{\text{Acetic acid.}}{C_2H_4O_2} + H_2O\,;$$

or it takes out four atoms of hydrogen, putting in two of oxygen, and so on; never an uneven number of atoms of hydrogen replaced by oxygen in one molecule.

The replacement of oxygen by sulphur produces no change of atomicity or of vapour volume.

The family of the five elements—nitrogen, phosphorus, arsenic, antimony, and bismuth—is also well known and universally admitted.

The analogous basic hydrides, or ethylides, on the ammonia type, are decisive of the analogy of the elements, but beyond them we have the series of acids analogous to nitrous acid and to nitric acid, and many isomorphisms.

The alkali metals, including lithium, rubidium, cæsium, and thallium, as well as silver, are eminently monatomic, for they all replace hydrogen atom for atom They form no basic salts. Their sulphates form with sulphate of alumina those characteristic salts called alums. Gold is monatomic in its protochloride, but triatomic in its common solation. Boron appears usually to be triatomic, as the constitution of its chloride and of its ethylide admits of no other formula. Carbon and silicon are usually tetratomic, but sometimes biatomic.

The remaining metals present so great a variety of properties that their classification is only effected by establishing among them some natural families, and connecting each family in succession with the biatomic or tetratomic elements. Thus magnesium, zinc, and cadmium form a well marked family of metals, all volatile, and forming very similar salts, and zinc is clearly proved to be biatomic by the constitution and properties of zinc, ethyl, $Zn(C_2H_5)_2$, which occupies the same vapour volume as ether, $O(C_2H_5)_2$.

Half the ethyl can be taken out of zinc ethyl and replaced by iodine without breaking up the molecule $Zn(C_2H_5)I$. The oxides of these metals have, therefore, the formulæ MgO,ZnO,CdO, while the chlorides are $MgCl_2,ZnCl_2,CdCl_2$, and the nitrates are $Mg(NO_3)_2$, &c.

Then, again, calcium, strontium, barium, and lead present in their salts many striking points of analogy, and abundant cases of isomorphism. The compounds $Pb(C_2H_5)_4$ and $Pb(C_2H_5)_3Cl$ prove lead to be tetratomic in its brown oxide, PbO_2, and biatomic in its common chloride, $PbCl_2$, and nitrate $Pb(NO_3)_2$, and we are, by analogy, led to extend the conclusion to the other metals of the family. The analogy and isomorphism of some lime salts, &c., with the corresponding salts of magnesia, would lead independently to the same conclusion. Carbonate of lime has thus the formula $CaCO_3$, which is so much like the formula of nitre, KNO_3, that our surprise is removed at the isomorphism of arragonite with the latter salt, or at that of nitrate of soda and calc spar.

Then iron, aluminium, chromium, and manganese form analogous and isomorphous sesquioxides which are capable of replacing one another in the alums; so that the metals must have a similar atomicity. Chromium is proved beyond dispute by the constitution of chlorochromic acid to be biatomic like sulphur, which forms the corresponding compound—chloro sulphuric acid; the conclusion is confirmed by the analogy and isomorphism of the sulphates and chromates. Chromium thus brings iron, aluminium, and manganese over with it to the class of even-atomicity metals. But manganese, from the properties of the manganates, would prove the same thing independently, and again in permanganate of potash, MnO_4K, the atom of manganese replaces the atom of chlorine in perchlorate of potash ClO_4K.

Nickel, cobalt, and copper are, moreover, known to form a variety of salts so analogous in constitution and crystalline form, &c., to the corresponding salts of iron, manganese, lime, and magnesia that their protoxides have been long designated as the magnesian family, and must be represented by biatomic formulæ such as $CuO,CuCl_2$, &c.

Then mercury in its higher chloride and the corresponding ethylide is undeniably biatomic, as tin is biatomic in its lower chloride $SnCl_2$, and tetratomic in its liquid chloride, and in the corresponding ethylide $Sn(C_2H_5)_4$.

Considerations of analogy serve to extend the conclusions to the remainder of the heavy metals, and to class them all with oxygen, and carbon, &c., as elements of even-atomicity, or, as Dr. Odling proposes to call them, "artiads."

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[*] Abstract of a discourse delivered before the Chemical Society, May 19, 1864. Communicated by the Author.

The conclusion of the paper was occupied by a consideration of various apparent objections to these general conclusions. Mercury and cadmium are known to have a vapour volume corresponding to one atom of each in the molecule of two volumes, but so have CO, SO_2, and C_2H_4.

Phosphorus and arsenic have four atoms in each molecule of vapour, being, doubtless, built up on the ammonia type. The sesquichlorides of iron, aluminium, and chromium are found to contain Fe_2Cl_6, &c., each molecule of vapour proving that these metals in their sesqui-salts still have an even number of "perissad" atoms in each molecule. The basic nitrate of lead, $PbNO, HO$, had been quoted in proof of the biatomic character of that metal, and the corresponding salt of mercury extends the conclusion to it.

In its subsalts mercury also forms basic compounds, which cannot be accounted for if the metal is there really monobasic like potassium. The basic subnitrate of mercury, Hg_2NO, HO proves for it exactly the same thing which the vapour volume of the sesquichlorides proves for them—viz., that their subsalts are no exceptions to the law of even-atomicity for these metals.

On Some New Double Salts of Chromic Acid, and their Photographic Applications, by M. E. Kopp.

The starting point of these researches was an unsuccessful attempt to prepare ammonic chromate.

I tried to obtain this salt by dissolving an equivalent of bichromate of potash in caustic ammonia, and adding to the concentrated solution a boiling solution of one equivalent of ammonic sulphate. I hoped that slightly soluble sulphate of potash would be deposited, and that neutral ammonic chromate would remain in solution.

But if concentrated liquids are used, masses of double chromates are formed, crystallising in needles, crusts, &c., in the midst of the sulphate of potash; and if the solutions are diluted, too much of the latter salt remains in solution.

Having isolated a certain quantity of crystals in needles, it became easy to ascertain that they constituted a double chromate of potash and ammonia, and it was interesting to further examine this salt, which has not yet been described.

Double Chromate of Potash and Ammonia.—By finely pounding bichromate of potash with concentrated caustic ammonia we get a straw-coloured magma, whilst the ammonia is in excess; on being left in contact with the air, the ammonia disappears, and the mass takes a gradually deepening orange tint.

By dissolving with heat bichromate of potash to saturation in caustic ammonia, a large quantity of ammoniacal gas is disengaged by boiling, and on cooling there is generally obtained a mixture of crystals, some yellow and others orange.

The following is the best method for preparing pure double chromate of potash and ammonia:—

First obtain, by several re-crystallisations, some perfectly pure bichromate of potash. Introduce a certain quantity of this salt into a sufficiently strong spherical flask, and into it pour pure and concentrated liquid ammonia, shaking constantly until the strong and persistent odour of ammonia indicates an excess of volatile alkali.

Stopper the flask well, and heat it in a water bath until the contents are completely dissolved. On cooling the double salt crystallises in abundance and in a perfectly pure state. Open the flask, decant the mother liquor, and dry the crystals under a receiver over quick lime, and in a slightly ammoniacal atmosphere.

Under rapid crystallisation double chromate of potash and ammonia crystallises in long, fine, and transparent needles of a light sulphur colour, or in four-sided prisms, apparently with rhomboidal base, the summits of which are frequently feather-edged, in consequence of the replacing of one or two edges by inclined facets.

By slow crystallisation of not too much concentrated liquids after slow cooling, sufficiently bulky crystals are obtained.

The mother liquors of crystals left to evaporate slowly under the receiver did not give very distinct and well-defined crystals, on account of the tendency of the salt to accumulate along the sides.

The same mother liquors left in contact with the air in a precipitating vessel, covered with paper, gave a bulky sulphur-coloured efflorescence, containing both potash and ammonia, and at the bottom of the liquid orange-coloured crystals of bichromate of potash.

Double chromate of potash and ammonia contains no water of crystallisation. The formula of the salt is $CrO_3, KO + CrO_3, NH_3, HO$.

One gramme of the salt dissolved in water containing acetic acid, precipitated by acetate of lead, gives a precipitate of chromate of lead, which, washed and dried at 100°, weighs 1 gr. 870, corresponding to 57·97 per cent. of chromic acid. A slight excess of sulphuric acid is added to the washings, which are then evaporated to dryness, recovered by water, filtered, and again evaporated to dryness in a crucible; after calcination at red heat, and the occasional addition of morsels of ammonic carbonate, a residue of sulphate of potash remained weighing 0 gr. 500, corresponding to 27.04 per cent. of anhydrous caustic potash.

In a second analysis 1 gramme of a salt of another preparation (which had probably already lost a little ammonia) furnished 1 gr. 88 of chromate of lead, corresponding to 58·28 per cent. of chromic acid.

The formula $CrO_3.KO + CrO_3NH_3HO$ requires ($O = 100$).

		Calculation.	Experiment.	Experiment.
$2CrO_3$ . .	1256·00	57·88	57·97	58·28
KO . . .	589·00	27·15	27·04	
NH_3 . .	212·50	9·79		
HO . . .	112·50	5·18		
	2170·00	100·00		

The formula $Cr_2O_6.KO + H_3N$ would require 61·04 per cent. of chromic acid, and the formula

$$Cr_2O_6.KO + H_3N + 2HO,$$

would correspond to 55·03 per cent. of CrO_3.

Properties of Double Chromate of Potash and Ammonia.—On exposure to the air, the salt gradually loses its ammonia and acquires an orange tint. The decomposition is remarkably retarded when the salt retains no more ammonia than corresponds to a potassico-ammonic sesquichromate.

Heated very gradually, the salt loses all its ammonia, finally leaving a red salt, which is fused bichromate of potash.

Heated rapidly, a certain quantity of chromic acid is reduced, and water is formed at the expense of the ammonia.

The solution of the salt, evaporated or boiled for a long time, also loses its ammonia, and is converted into a solution of bichromate of potash.

This property of double chromate of potash and ammonia of losing its ammonia by dessication and vaporisation, leaving an acid salt as residue, and consequently containing nearly free chromic acid, makes it probable that it may be usefully applied in the arts, and among others to calico printing.

In fact, the more neutral the salt the more feeble comparatively are its oxidising properties; but they become more and more evident as the ammonia is disengaged, and reactions then take place, a few of which we will proceed to describe.

In this way, for instance, alkaline hyposulphites, phosphorus, etc., can remain for an almost indefinite time in contact with a neutral solution of alkaline chromate without the occurrence of any reaction; but as soon as the chromate changes to bichromate the chromic acid is reduced, and the bodies capable of absorbing oxygen are oxidised.

It is often advisable to add to the potassico-ammoniacal chromate an equivalent of ammoniacal chloride, sulphate, nitrate, ammonic phosphate, for the purpose of converting all the chromic acid into ammonic chromate, the potash combining with the acid of the ammonic salt.

In the same way neutral potassic chromate may be used, or potassic bichromate saturated with soda ($Cr_2O_6.KO + NaO$), to which a proportional quantity of ammonic salt may be added, then after double decomposition the mixture may be considered as formed of a salt of potash or soda and of ammonic chromate; but the double salt of which we are treating will always have the advantage of introducing the smallest possible amount of inert potassic or sodic salts into the colour or into the reaction produced by the reduction of chromic acid. The results of a series of experiments—made, it is true, only on a small scale—favour the opinion that the use of potassico-ammonic chromate, or of mixtures similar to those above described, will be found equally advantageous on a large scale in the preparation of colours which require oxidation for the development of the full richness of their tints, such as the colours with base of dye wood, as log-wood, Brazil wood, Japan earth, tannin, aniline, toluidine, phenol, naphthylamine, &c.

(To be continued.)

Researches on Silico-Tungstic Acids,
by M. C. Marignac.

By boiling, with gelatinous silica, the solution of an acid tungstate of potash or soda, a certain quantity of silica is dissolved, the liquid takes an alkaline reaction, and contains an acid in which 1 equivalent of silica is combined with 12 equivalents of tungstic acid ($SiO_2 12WO_3$), and which I name silico-tungstic acid. This is an energetic and very stable acid, easily extracted from its salts, forming two hydrates in magnificent crystals, and most of its salts, which are very soluble, crystallise well.

Acid tungstate of ammonia forms, under similar circumstances, another acid, in which 1 equivalent of silica is combined with 10 equivalents of tungstic acid ($SiO_2 10WO_3$); this I call silico-decitungstic acid. It is much more difficult to extract this acid from its salts in a pure state; it forms an uncrystallisable hydrate, drying into a vitreous, brittle, very deliquescent mass. The extreme solubility of most of these salts renders their crystallisation difficult; they are, moreover, unstable.

Silico-tungstic acid has itself very little stability. It is almost impossible to dry without decomposing it. A very small quantity of silica is separated, and a new acid is thus obtained in which silica and tungstic acid are present exactly in the same proportions as in silico-tungstic acid, but differing from it in every respect; to this I give the name of tungsto-silicic acid. It forms a very soluble, and even slightly deliquescent hydrate, but from it may be obtained voluminous and perfectly determined crystals. It also forms a series of salts, which, though isomeric with silico-tungstates, differ from them in crystalline forms and in the proportions of water of crystallisation.

They seem in general more soluble than silico-tungstates (which are highly soluble) but less so than silico-decitungstates.

These three acids are quadribasic, considering as neutral those salts with 4 equivalents of base which are always formed when they are made to act on carbonates. The most frequent salts are those with 2 or 4 equivalents of base; the first generally crystallise most easily. As might be supposed from their polybasic nature, these acids have a strong tendency to form double salts. Thus ammonia does not precipitate a solution of silico-tungstate of alumina; but, on the contrary, alumina, as well as magnesia, carbonate of lime, &c., easily dissolves by boiling in a solution of silico-tungstate of ammonia.

Alcohol dissolves these acids quite as well as water. Perfectly anhydrous ether has a great affinity for them, and liquefies them, forming a syrupy, limpid liquid, insoluble in an excess of ether, miscible, on the contrary, in any proportion with cold water; but under heat the liquid becomes troubled, and the ether separates.

The salts of these acids being very soluble, and containing a very considerable proportion of tungstic acid, form solutions remarkable for their density—for instance, the solution of neutral silico-tungstate of soda, the density of which is 3·05; so that glass, quartz, and most stones float on this liquid, which is, however, very fluid.

Silico-tungstic acid crystallises at the ordinary temperature in large octahedral squares, the angles of which differ but little from those of the regular octohedral, containing 29 equivalents of water of crystallisation, according to the formula—$SiO_2 12WO_3 4HO + 29Aq$.

It begins to fuse towards 36°, and is completely liquified in its water of crystallisation at 53°.

When it crystallises at the ordinary, or a rather higher temperature, in presence of alcohol, hydrochloric, or sulphuric acid, it forms a hydrate containing only 18 equivalents of water of crystallisation. Then it presents the appearance of cubo-octahedral crystals; but this effect is really produced by the combination of two based rhombohedrals.

Dried at 100°, this acid retains, besides the combined water, 4 equivalents of water of crystallisation. Heated to 220° it not only loses these latter, but retains only 2 equivalents of basic water, which alone seem necessary to the formation of this acid. These it retains up to 350°, undergoing no alteration at this temperature. In this state it becomes strongly heated by contact with water, re-dissolves and re-crystallises without undergoing any change. Not till near red heat is the rest of the water expelled; at the same time the acid becomes yellow and insoluble, decomposing, probably, into a mixture of tungstic and silicic acid.

Tungsto-silicic acid crystallises with 20 equivalents of water of crystallisation, according to the formula—

$$12WO_3 SiO_2 4HO + 20Aq.$$

These crystals belong to the system of non-symmetrical oblique prisms. In humid air they become deliquescent.

On decomposing this acid by heat it undergoes the same changes as silico-tungstic acid. It possesses the same stability; boiling with acids, evaporation to dryness with aqua regia, fail to determine its decomposition.

I have applied myself to the crystallographic study of many of the salts of these acids. My studies have not led me to any curious relation to other combinations, since these acids seem to belong to a new type of compounds. However, comparisons between the forms of a certain number of these salts give some interesting results. During my examination I was struck with the incontestible analogies of form between compounds of which it is difficult to admit the isomorphism. Thus the forms of acid silico-tungstates of baryta and lime are identical with those of free silico-tungstic acid crystallised with heat. It is true that the proportions of water of crystallisation are the same, so that they present a positive example of isomorphism of water with lime and baryta. But I find it impossible to admit this isomorphism, not only because no other example has ever been found, but more especially because it seems to be theoretically impossible, baryta and lime being the bases of a single atom of metal, while water contains 2 atoms of hydrogen.

Several other coincidences of forms, for instance, between salts of soda, entirely different in the proportions of their base and water of crystallisation, have led me to ascribe these facts to the intervention of a general cause, whose influence I do not, however, pretend to be the first to have observed, and also to a necessary extension of Mitscherlich's fundamental principle of isomorphism. It must, I think, be admitted that when two compound bodies contain an element or a group of elements in common, forming the greater part of their weight, these compound bodies may, from that cause alone, be isomorphous, even when the rest of the elements, wherein they differ, do not constitute a similar atomic or isomorphous grouping in the two compounds.

M. Scheibler's excellent memoir on metatungstates has already furnished a remarkable example of this principle, for he has established that most salts of this kind are isomorphous, though they contain very different proportions of water as to the number of atoms they represent, but which vary only between 12 and 15 per cent. of the total weight of these salts. Moreover, I believe that many of the coincidences of form observed between certain minerals whose atomic constitution does not seem to justify their being called isomorphous are ascribable to this simple cause, without having recourse to the more or less complicated systems devised by some mineralogists.

If, as I believe, this principle is true, we must henceforth exercise great reserve in assuming the isomorphism of two bodies from that of the complex compounds into which they may enter. It also proves how vain are the attempts made to derive the crystalline form of a compound solely from a consideration of the number of atoms of various elements entering into its composition.—*Comptes-Rendus*, lviii., 809, 1864.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following papers will be read:—"On the Identity of Methyl and Hydride of Ethyl," by Dr. Schorlemmer; "On Vacuum Experiments," by Dr. Sprengel.

TECHNICAL CHEMISTRY.

Further Remarks on the Conversion of Salt Meat into Fresh by Means of Dialysis, by S. Johnson, *Esq.*

Seeing a note on this subject in the Chemical News May 28, by Mr. Whitelaw, I may be permitted to offer a few suggestions, which, perhaps, may prove of some value.

The question of utilising the carcases of animals killed for the sake of their skins in the colonies is one of great importance, as millions annually when stripped of their hides are thrown away, and are permitted either to decompose or become the food of beasts and birds of prey. Many of your readers, I am sure, have heard of the ingenious process for preserving meat, devised by Dr. Morgan, which was brought under the attention of the Society of Arts a short time ago. The invention consists in making use of the blood-vessels in the same manner as nature does when impelling the blood in the animal economy, displacing the blood, and substituting therefor an antiseptic liquid. By this means the meat is completely impregnated in a few minutes, for the liquid finds its way into the most minute ramifications of the veins, and consequently permeates the flesh as completely as the system of blood-vessels does; added to this, the membrane which forms the veins and arteries is an excellent dialytic medium, consequently the antiseptic substances soon dialyse through the membranes and tissues into the animal juices, thus curing the meat as perfectly as it can be done.

An idea which struck me forcibly on hearing an account of Dr. Morgan's invention is, that by reversing the process—that is, by dialysing the brine, &c., out of the tissues—the meat would be again made quite fresh. In order to accomplish this, a gentle current of water should be made to circulate the system of blood-vessels; in a short time, I have no doubt, by this treatment, but a mere trace of the antiseptic reagents would remain. The system of blood-vessels in this case corresponds to Mr. Whitelaw's dialytic bag. I may remark that of course it is necessary that the carcases of the animals be preserved entire, consequently this method of treating meat would have special reference to Dr. Morgan's process, which, without doubt, sooner or later, must come into general use.

In the case of introducing phosphates, &c., into the meat used on shipboard, for the purpose of supplying, to some extent, a want created by the absence of fresh vegetable food, as proposed by Dr. Morgan, the materials used should be introduced after the curing reagents have been removed.

It seems to me, also, that the objection to the curing of meat by means of creosote or phenic acid, which exists in the difficulty of removing the flavour, may possibly by this means be surmounted.

It may be interesting to remark that the contraction and expansion of the meat mentioned by Mr. Whitelaw, as due to the action of salt, is brought about by osmose.

10, Bonner's Road, Victoria Park.

Poison Bill.—Mr. H. Berkeley has given notice in the House of Commons that, on the 7th of next month, he shall ask leave to introduce a bill to amend the Act prohibiting the sale of poisoned seed, passed last session.

Simpson v. Holliday.—This important trial commenced on Wednesday, before Vice-Chancellor Page Wood. We shall give an abstract of the chemical evidence next week.

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.

Thursday, May 26, 1864.

Professor W. A. MILLER, *V.P., in the Chair.*

(*Continued from page 270.*)

A paper "*On the Spectra of some of the Fixed Stars,*" by W. HUGGINS, F.R.A.S., and Professor W. A. MILLER, was then read. After a few introductory remarks, the authors describe the apparatus which they employ, and their general method of observing the spectra of the fixed stars and planets. The spectroscope contrived for these inquiries was attached to the eye-end of a refracting telescope of 10 feet focal length, with an 8-inch achromatic object-glass, the whole mounted equatorially and carried by a clock-movement. In the construction of the spectroscope, a plano-convex cylindrical lens, of 14 inches focal length was employed to convert the image of the star into a narrow line of light, which was made to fall upon a very fine slit, behind which was placed an achromatic collimating lens. The dispersing portion of the arrangement consisted of two dense flint-glass prisms, and the spectrum was viewed through a small achromatic telescope with a magnifying power of between 5 and 6 diameters. Angular measures of the different parts of the spectrum were obtained by means of a micrometric screw, by which the position of the small telescope was regulated. A reflecting prism was placed over one half of the slit of the spectroscope, and by means of a mirror, suitably adjusted, the spectra of comparison were viewed simultaneously with the stellar spectra. This light was usually obtained from the induction spark taken between electrodes of different metals. The dispersive power of the apparatus was sufficient to enable the observer to see the line *Ni* of Kirchhoff between the two solar lines D; and the three constituents of the magnesium group at *b* are divided still more evidently.[*] Minute details of the methods adopted for testing the exact coincidence of the corresponding metallic lines with those of the solar and lunar spectrum are given, and the authors then proceed to give the results of their observations. Careful examination of the spectrum of the light obtained from various points of the moon's surface failed to show any lines resembling those due to the earth's atmosphere. The planets Venus, Mars, Jupiter, and Saturn were also examined for atmospheric lines, but none such could be discovered, though the characteristic aspect of the solar spectrum was recognised in each case; and several of the principal lines were measured, and found to be exactly coincident with the solar lines. Between forty and fifty of the fixed stars have been more or less completely examined; and tables of the measures of about 90 lines in Aldebaran, nearly 80 in α Orionis, and 15 in β Pegasi are given, with diagrams of the lines in the two stars first named. These diagrams include the results of the comparison of the spectra of various terrestrial elements with those of the star. In the spectrum of Aldebaran coincidence with nine of the elementary bodies were observed, viz., sodium, magnesium, hydrogen, calcium, iron, bismuth, tellurium, antimony, and mercury; in seven other cases no coincidence was found to occur. In the spectrum of α Orionis five cases of coincidence were found—viz., sodium, magnesium, calcium, iron, and bismuth; whilst in the case of ten other metals no coincidence with the lines of this stellar spectrum was found. β Pegasi furnished a spectrum closely resembling that of α Orionis in appearance, but much weaker; only a few of the lines admitted of accurate measurement, for want of light; but the coincidence of sodium and magnesium was ascertained; that of barium, iron, and manganese was doubtful. Four other elements were found not to be coincident. In particular, it was noticed that the lines C and F, corresponding to hydrogen, which are present in nearly all the stars, are wanting in α Orionis and β Pegasi. The investigation of the stars which follow is less complete, and no details of measurement are given, though several points of much interest have been ascertained. Sirius gave a spectrum containing five strong lines, and numerous finer lines. The occurrence of sodium, magnesium, hydrogen, and probably of iron, was shown by coincidence of certain lines in the spectra of these metals with those in the star. In α Lyræ the occurrence of sodium, magnesium, and hydrogen was also shown by the same means. In Capella sodium was shown, and about twenty of the lines in the star were measured. In Arcturus the authors have measured about thirty lines, and have observed the coincidence of the sodium line with a double line in the star spectrum. In Pollux they obtained evidence of the presence of sodium, magnesium, and probably of iron. The presence of sodium was also indicated in Procyon and α Cygni. In no single instance have the authors ever observed a star spectrum in which lines were not discernible, if the light were sufficiently intense and the atmosphere favourable. Rigel, for instance, which some authors state to be free from lines, is filled with a multitude of fine lines. Photographs of the spectra of Sirius and Capella were taken upon collodion; but, though tolerably sharp, the apparatus employed was not sufficiently perfect to afford any indication of lines in the photograph. In the concluding portion of their paper, the authors apply the facts observed to an explanation of the colours of the stars. They consider that the difference of colour is to be sought in the difference of the constitution of the investing stellar atmospheres, which act by absorbing particular portions of the light emitted by the incandescent solid or liquid photosphere, the light of which in each case they suppose to be the same in quality originally, as it seems to be independent of the chemical nature of its constituents, so far as observation of the various solid and liquid elementary bodies, when rendered incandescent by terrestrial means, appears to indicate.

The next paper was "*A Comparison of the most Notable Disturbances of the Magnetic Declination in 1858 and 1859 at Kew and Nertschinck,*" by General Sabine. The titles of the following papers were afterwards read:—"*A Second Memoir on Skew Surfaces, otherwise Scrolls,*" Professor Cayley. "*On the Differential Equations which determine the Forms of the Roots of Algebraic Equations,*" Professor Boole.

CHEMICAL SOCIETY.

Thursday, May 19, 1864.

ROBERT WARINGTON, *Esq., Vice-President, in the Chair.*

IN continuation of our report of this evening's proceedings, we now give an abstract of the "*New Method of Gas Analysis,*" which has been elaborated conjointly by the President and Dr. Russell. The apparatus employed (of which we present a sectional sketch), was fitted up in the meeting room for the inspection of the Society, and its construction and use were very fully explained by Dr. Russell. The leading principle of this mode of analysis—wherein it differed at once from the methods of Bunsen, Regnault, and Frankland—was the dispensing with the barometer and thermometer, and the substitution of a standard volume of air with which the gas under examination was compared when brought, by very simple means, to the same pressure and temperature; and the advantages claimed for this method were increased rapidity and simplicity. The construction of the apparatus was described as follows:—A cast-iron mercury trough was formed with straight tubes depending, so as to allow of the eudiometer, &c., being wholly immersed in the liquid metal, and at the same time the figure of the trough reduced to a minimum the quantity of mercury required to fill it. This trough was supported on a triangular wooden stand, with table-top fixed at a convenient height, upon which substantial iron rods were mounted for holding the several pieces of glass apparatus, and the telescope employed in reading the graduated divisions on the eudiometer; upon the opposite side of this table were also placed the gas lamp and paper screen for showing a bright diffused light. The glass apparatus consisted of (A) pressure tube containing the standard volume of air; (B) Bunsen's eudiometer; (C) a supplementary glass bulb, having a large lower orifice closed firmly by pressure upon a pad of india-rubber and metal. This is termed the "laboratory vessel;" it is here that all absorptions are conducted. D is a syphon tube of small internal diameter, and serves in transferring the gas from the eudiometer to the laboratory vessel, and *vice versa.* The length of the shorter limb must, of course, be equal to, or slightly exceed, the height of the eudiometer, and its longer limb be conducted inside and to the very top of the laboratory vessel, the convexity of which favours the escape of every trace of gas, particularly if the head of the syphon tube be itself rounded to correspond. E is a glass tube of greater length than thirty inches, the lower extremity of which may be closed by pressure exerted by means of a clip upon a short piece of caoutchouc tubing; its upper end is firmly secured through the caoutchouc pad with the laboratory vessel; this tube having been filled with mercury, and standing in a small cistern of the same metal, it is manifest that by opening the spring clip at the lower caoutchouc joint, a Torricellian vacuum will be created, and the laboratory vessel be emptied of mercury, so that afterwards the gas in the eudiometer will at once pass over upon opening the intermediate syphon communication. The inventors prefer to use the chemical reagents either in a solid or plastic condition. For instance, in absorbing carbonic acid, they would paint the interior of the laboratory vessel with fused hydrate of potassa, using for such application an iron-wire brush. The rate of absorption was slower than when the alkali was employed in the form of a solution; but there was no difficulty in absorbing from 18 to 20 per cent. of carbonic acid from a gaseous mixture containing this proportion in the space of about five minutes. Pyrogallic acid and potassa, with a minimum of water, was employed for absorbing oxygen; and for the removal of hydrocarbons the coke bullets as usual. For the perfect exclusion of air from the laboratory vessel, it was recommended to damp the edges of the caoutchouc pad and to let fall a few drops of water around the outside junction of the glass and mercury. A convenient mode of refilling this vessel with mercury when the absorption was completely effected consisted in admitting from a reservoir at higher level the requisite quantity of mercury, after having closed by its clamp the lower orifice of the 30-inch tube; and in using a length of vulcanised rubber tubing for this purpose, it was desirable to keep it slightly moistened, both externally and internally. It may be sometimes necessary to alter the level of the mercury in the trough. This is best accomplished by sinking or raising a thick glass cylindrical tube, supported constantly at one end of the iron trough. The eudiometer and standard pressure tubes are each supported by long upright rods of steel, which pass with friction through ferrules or collars attached to the substantial mountings of the apparatus. Adjustments in height are easily controlled by loosening the set screws and turning a spindle, around which is wound a cord of catgut. The height of the mercurial level is read off against a horizontal black bar, which is carried by the steel upright of the pressure tube; and when the standard line is in exact adjustment, the telescope is turned aside, and the calibrations of the eudiometer thus brought into view. If, therefore, the levels are exactly coincident, the volume of gas in the eudiometer must correspond in pressure with the air enclosed within the standard tube; and, further, if the two tubes are surrounded with an outer glass cylinder filled with water, the temperatures must also be identical. The construction of the telescope is very simple; it has only a single lens and crossed wires, but no eye-piece; a very small aperture in front keeps the eye in the proper line of vision, and on the top is a spirit-level to show when it is fixed horizontally. A convenient volume of gas to operate upon was 200 millimeters, and in estimating the proportion of oxygen in air the authors had arrived at the

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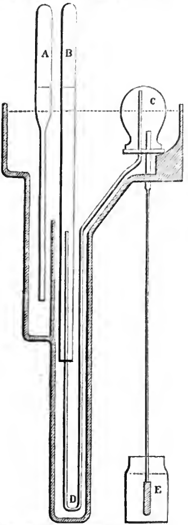
[*] Each unit of the scale adopted was about equal to $\frac{1}{1000}$th of the distance between A and H in the solar spectrum. The measures on different occasions of the same line rarely differed by one of these units, and were often identical.

Williamson and Russell's Apparatus for Gas Analysis.



A. Pressure-tube containing standard volume of air.
B. Bunsen's eudiometer.
C. Laboratory vessel in which absorptions are conducted.
D. Syphon-tube for transferring gas from B to C, and *vice versa.*
E. Column of mercury and cistern for producing vacuum in C.

following numbers in a series of experiments upon two samples, viz. :—

Oxygen in 100 parts of Air.

I.—21·003 20·997 20·991.
II.—20·976 20·966 20·962.

Carbonic Acid in a Mixed Gas.

I.—18·65 per cent.
II.—18·67 „

	Taken.	Found.
Carbonic acid	12·34	12·40
Oxygen	15·51	15·52
Nitrogen	72·15	72·08

Another experiment (not reduced to percentages) :—

	Taken.	Found.
Carbonic acid	44·14	44·14
Oxygen	31·39	31·41
Nitrogen	182·45	182·43

Dr. Russell's description was supplemented by a few remarks on the part of the President, who narrated some of his difficulties in maintaining a vacuum over mercury. When all the parts of the apparatus were dry the air entered at a great speed, and even with the use of water to cover the joints he sometimes had observed a bubble of air as big as a pea collect in the space of ten minutes; in such cases he attributed its appearance to the solution of the air in water and subsequent liberation in a vacuum. By applying a strong pressure in forcing down the laboratory vessel upon its caoutchouc pad this annoyance could be overcome.

A vote of thanks to the President and Dr. Russell for their interesting communication was carried with acclamation.

Professor Wanklyn then gave a short account of experiments, by Dr. Erlenmeyer and himself, "*On Isomeric Hydrocarbons.*" Referring to the law expressive of the composition of the hydrocarbon series, it was assumed that their constitution was invariably $C_nH_n + _2$. Products were, however, obtained which differed widely in chemical character, although having an identical composition; thus, Schorlemmer had described a hydrocarbon having the formula C_6H_{14}, and Cahours and Pelouse obtained another substance from mineral oil, but these had very different properties from the β hydride of hexyl prepared by the authors. The latter was remarkable for its power of resisting the action of chlorine and oxidising agents, and when eventually compounds were formed, it was found that the original type was destroyed by the splitting up of the substance into representatives of distinct series.

The Chairman announced that M. Aupin, pupil of Professor Malaguti, had succeeded in detecting silver in the saline residue obtained on evaporating the water of the Dead Sea. One milligramme of silver was contained in two kilogrammes of the saline matter. (One part of the precious metal in two million parts of salt, or seven grains to the ton!)

The President then addressed the Society on the subject of "*The Classification of the Elements according to their Atomic Weights.*" At the outset the author stated that he had no experiments to bring forward, but merely suggestions to offer in regard to the work of others. It appeared that the elements were capable of division into two groups, the first of which only furnished an *even* number of atoms to any molecule; the remainder, or second group, including those which furnished either an *odd* or *even* number of atoms to any molecule. In the first group were enumerated the following elements:—Hydrogen, fluorine, chlorine, bromine, iodine, [lithium, sodium, potassium, cesium, rubidium, thallium], silver, [nitrogen, phosphorus, arsenic, antimony, bismuth], boron, gold. Adopting the suggestion of Gerhardt, it had been determined to double the atomic weights of oxygen, carbon, sulphur, and selenium, and the remaining elements must assume a corresponding equivalentic value. The President considered it important that chemists should at once agree as to what were the right atomic weights, and adopt without delay a common language; a full and early discussion of the whole subject was, therefore, paramount. The author stated the grounds for his removing fluorine from the oxygen group, and placing it beside chlorine; this was, however, a troublesome element in many respects, for it did form acid-salts, which was never the case with chlorine; thus the existence of the fluoride of potassium and hydrogen might be adduced as an argument in favour of placing fluorine at the head of the oxygen family. The history and present state of the hypothetical views brought forward in support of the new atomic theory were treated of at great length by the lecturer, as will be seen by the abstract at page 277, communicated by the author.

In adjourning the meeting until June 2, the Chairman announced that Professor Stokes would then address the Society, taking for his subject "*The Detection and Discrimination of Organic Substances by means of their Optical Properties.*" On June 16 an ordinary meeting would be held; and on June 30 Mr. Way's lecture "*On the Philosophy of British Agriculture*" would be delivered.

Thursday, June 2, 1864.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

The minutes of the preceding meeting having been read and confirmed and the several donations to the Society's library announced, and acknowledged by a vote of thanks, the members proceeded to ballot for the election of Mr. Charles Tomlinson, Lecturer on Experimental Science, King's College, who was duly received as a fellow of the Society. Mr. M. Prentice was then formally admitted by the President, after having attached his signature to the book of obligations.

The President at once invited Professor G. G. Stokes, Sec. R. S., to favour the meeting with the discourse "*On the Detection and Discrimination of Organic Bodies by means of their Optical Properties,*" which he had kindly promised to deliver.

The Lecturer said he felt some little hesitation in appearing before such an audience as the present, chiefly from the circumstance that he had no new chemical facts to offer; he did not profess, indeed, to have more than a general acquaintance with the latest results of chemical research; but inasmuch as no one branch of science can be said to stand alone, he believed it desirable that chemists should be induced to avail themselves of the valuable auxiliary aid which was to be gained by a more extended application of some of the principles of optics. The researches of Professors Bunsen and Kirchhoff, Talbot, Wheatstone, Miller, and others, had already paved the way for future experimentalists, but he considered that much remained to be done before it could be said that the optical properties of the elements and their chemical compounds received as much attention, or were as well known, as the remainder of their physical characters. He regretted also that Gmelin's Handbook, and other standard works on chemistry, contained erroneous descriptions in regard to these optical properties; thus, it was sometimes stated that a substance appeared of a certain colour by transmitted light, and of another specific colour by *reflected* light, when, in the latter case, reflection had little or nothing to do with the phenomenon. The properties most available for the chemist were colour-production by absorption, fluorescence, and reflection, and the phenomena of circular polarisation in a limited number of instances; but the measure of the refractive and dispersive powers was of no value in the examination of mixed solutions. The lecturer proceeded to define the principle of absorption, taking a blue solution of copper as an illustration, and then showed a very simple arrangement of apparatus for the purpose of observing these effects. It consisted of a small glass prism, having a refracting angle of 60 degrees, mounted vertically at one end of a long wooden tube, the other end of which was closed with exception of a narrow slit regulated by a screw; and against the outside of this aperture, and in front of the lamp a test-tube, or wedge-shaped vessel, containing the solution to be examined, could be supported by means of elastic bands. Even this arrangement might be simplified by holding in one hand the prism, and in the other a separate black board carrying the test-tube and narrow aperture for the admission of light. It was always desirable to make examination of the substance in different degrees of dilution, and especially to guard against the employment of too highly concentrated solutions. Dr. Gladstone preferred the use of a wedge-shaped vessel for holding the liquid, because it readily permitted of viewing different thicknesses; but the lecturer thought the test-tube method more easy of adoption in the laboratory. When a very dilute solution of permanganate of potash was viewed through the prism, it was found to absorb many of the rays which corresponded with the middle of the solar spectrum, and when properly observed there would appear five dark bands of absorption at regular intervals between the fixed lines D and F of Frauenhöfer. By boiling the black oxide of manganese with sulphuric acid, a pink solution was obtained, the red hue of which was formerly supposed to be due to the presence of a small quantity of permanganic acid; but the optical examination showed that this could not be the case, for no traces of the dark bands were visible in the spectrum of this solution. The chromates were distinguished by the complete manner in which they cut off the blue and violent rays. Among the vegetable colouring matters, purpurin, from madder, had distinctive properties. The red solution obtained by boiling madder with alum gave three bands between the lines D and F, that nearest to F being fainter than the others. So delicate was this optical test that the author many years ago detected this constituent in dyed calico, a single grain weight of which was boiled with the aqueous infusion of 100 grains of black tea. Madder itself contained several colouring principles, but the purpurin could easily be isolated by shaking the acidulated extract with ether, in which it was pretty soluble. The position of these dark bands in the spectrum was subject to a shifting through the space of a band-interval; this was effected by the addition of an alkali, as well as by other chemical reagents, the whole group suffering a diminution in refrangibility, or progression nearer towards D. If to the liquid a blue cupro-tartrate be added, one band alone was left visible. The solution of tartrate of alumina had so great an affinity for purpurin that it would withdraw the whole of this colouring matter from its ethereal solution, forming a compound which was powerfully fluorescent. Dr. Stenhouse had supplied the author with a mixed colouring matter in which all three of the madder principles were contained—viz., alizarin, purpurin, and rubiacin, and in a piece of the dry material no larger than a pin's head all three substances were distinctly recognised. The double carbonate of uranium and soda showed four bands in the region of the fixed line G. It would be observed that the optical method of examination was only applicable to clear solutions, and in this respect contrasted strangely with the processes of precipitation generally resorted to by the chemist.

(To be continued.)

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 15, 1864.

"*On the Chemical History and Application of Gun-cotton,*" *by Professor* Abel, *F.R.S., Chemist to the War Department.*

(Continued from page 270.)

A rapid current of air will also effect the transformation of the combustion of gun-cotton from the ordinary to the slow form if the yarn be enclosed in a moderately wide glass tube, with one end protruding from the tube so that it may be inflamed in the ordinary manner, but, unless the current be very rapid, an explosive mixture of air and the inflammable gases generated from the gun-cotton may be produced in the tube, and become ignited, in which case the gun-cotton will flash into flame instantaneously, and the tube will be shattered by the explosion. If, however, a long piece of thin gun-cotton yarn be passed through a small, narrow, glass tube, one or two inches long, into which it fits so loosely that it may be drawn through very easily, the change in the form of combustion is effected with certainty and without the aid of a current of air. When the gun-cotton thus arranged and placed upon a flat surface is inflamed at one extremity, it burns as usual until it reaches the one opening of the tube; the slow form of combustion then takes place within the tube, and the gun-cotton will continue to burn in the slow manner, emitting only the small tongue of flame after the combustion has reached the portion of yarn on the other side of the tube, which will be entirely burned in this peculiar manner. In fact, to change the ordinary into the slow form of combustion of the gun-cotton yarn in *open air*, it is only necessary to pass a piece of the material through a perforation in a diaphragm of wood, cardboard, or paper, and to allow it to rest upon a flat surface on both sides of the diaphragm. The gun-cotton will burn as usual upon one side of the screen, until its combustion reaches the perforation, when the large bright flame will vanish and the gun-cotton upon the other side of the screen will burn in the slow manner to the end.

The two last experiments show that, if the combustible mixture of gases evolved by the action of heat upon gun-cotton when it is inflamed in open air are prevented, even for the briefest space of time, from completely enveloping the burning extremity of the yarn or twist; or, in other words, if they are forced for an instant to escape only in a direct line with the burning surface of gun-cotton from which they are emitted, those particles of the latter which are in immediate proximity to the burning portion cannot be raised to the temperature necessary for their rapid and more complete combustion, and hence the gases themselves are, in turn, not supplied with sufficient heat for their ignition. Now, as the gases which escape unburned convey away a very large portion of the heat developed by the metamorphosis of the gun-cotton, it is impossible for the latter to continue to burn otherwise than in the slow and imperfect manner. If, however, a flame or highly heated body be held in the path of the gases as they escape, they will at once be ignited, and the yarn will burst into the ordinary form of combustion. The correctness of this explanation may readily be demonstrated by two or three simple experiments. Thus, if a piece of loose or open gun-cotton-yarn is employed in place of the compact material which furnishes the results just described, it is very difficult, or even impossible, to cause the rapid combustion to pass over into the slow form, because the escaping gases cannot be diverted all into one direction, and cannot, therefore, be prevented from transmitting the heat necessary for perfect combustion from particle to particle of the material. Again, if a piece of the compactly-twisted gun-cotton yarn, placed upon a flat surface, is inflamed in the usual manner, and a jet of air is then directed in a line with the gun-cotton so as to meet the flame, the latter will appear to be blown out, though the cotton still burns; in fact, the burning gases are prevented for an instant from completely enveloping the extremity of the gun-cotton, and hence the combustion at once passes from the quick to the slow form. Conversely, if, when the yarn has been made to burn in this slow manner, a very gentle current of air be directed against the burning portion so as to force back upon the latter the gases which are escaping, thus impeding the rapid abstraction of heat, it will very speedily burst into the ordinary form of combustion, because, under these circumstances, the gases are almost immediately raised to the temperature necessary for their combustion. In the same way, if a piece of the yarn, placed upon a board, be made to burn in the slow manner, and one end of the board be gradually raised so that the burning extremity of the gun-cotton is the lowest, the latter will burst into flame as soon as the board has been raised to a position nearly vertical, so that the escaping gases flow back upon the burning surface.

The slow or imperfect form of combustion may be at once induced in the compact gun-cotton-yarn, in open air, by applying to any part of the gun-cotton a source of heat not sufficiently great to inflame the gases generated. A wire or metal rod, heated to any temperature between 135° C. to just below visible redness, or the spark of a thin piece of smouldering string, will invariably produce the result described. Of course, this effect, like most of the phenomena described, is to a considerable extent dependent upon the mechanical condition of the gun-cotton, upon the relation between the *quantity* as well as the *degree* of heat applied, and the amount of surface of the gun-cotton, and upon other conditions. While a small spark, or a thin platinum wire heated to full redness, only induces slow combustion in the compact gun-cotton yarn, a thick rod of iron heated only to dull redness will invariably inflame it in the ordinary manner. A piece of open yarn cannot be ignited so as to burn in the slow manner; on the other hand, the more compactly the gun-cotton is twisted, the more superficial is the slow form of combustion induced in it; indeed, the gun-cotton may be rendered so compact that it will simply smoulder in open air, if ignited as described, leaving a considerable carbonaceous residue; and the heat resulting from this most imperfect combustion will sometimes be abstracted, by the escaping gases, more rapidly than it is developed, so that the gun-cotton will then actually cease to burn, even in open air, after a short time.

The remarkable facility with which the effect of heat upon gun-cotton may be modified, so as even to produce results totally opposite in their characters, as exemplified by some of the experiments which have been described, renders it easily conceivable that this material may be made to produce the most varied mechanical effects, when applied to practical purposes; that it may, indeed, be so applied as, on the one hand, to develope a force, very gradual in its action, which may be directed and controlled at least as readily as that obtained by the explosion of gunpowder; while, on the other hand, it may be made to exert a violence of action and a destructive effect far surpassing those of which gunpowder is susceptible. The results arrived at in Austria, which show that gun-cotton can be made to produce effects from three to eight times greater than those of gunpowder, cease to be surprising after a study of the chemical and physical characteristics of this interesting explosive agent.

The products obtained by the explosion of gun-cotton and its decomposition under various conditions have as yet been very imperfectly studied, but there is little doubt that they vary in their nature almost as greatly as the phenomena which attend the exposure of the material to heat under different circumstances. It is well known that when gun-cotton is inflamed in the open air there is produced—in addition to water, carbonic oxide, carbonic acid, and nitrogen—a considerable proportion of binoxide of nitrogen, so that the gaseous mixture assumes a red-brown tinge, and becomes very acid, when it mixes with air. The products of the varieties of imperfect combustion which gun-cotton has been described as susceptible of undergoing are undoubtedly much more complex in their character than those just referred to. They include at times a proportion of some substances not yet examined, which make their appearance as a white vapour or smoke. Cyanogen can readily be detected in all the products of imperfect combustion. The proportion of binoxide of nitrogen is generally so large that the gaseous product becomes very highly coloured when mixed with air. Peroxide of nitrogen has also been observed in some instances. Lastly, there is little doubt that the products occasionally include a proportion of oxidising gases.

The products which have just been alluded to are the results of the decomposition of gun-cotton either at ordinary or diminished atmospheric pressures. When the explosion of the material is effected in a confined space, in such a manner that the main decomposition takes place under pressure, the metamorphosis which the material undergoes is of more simple and complete character.

It has been found by Karolyi that when gun-cotton is exploded by voltaic agency, in a shell which is burst by the explosion, and which is enclosed within an exhausted chamber so that the products of decomposition are collected without danger, the results obtained, under these conditions, are comparatively simple; the analysis of the contents of the chamber after the explosion showed that they consisted of—Carbonic acid, 20·82 per cent.; carbonic oxide, 28·95; nitrogen, 12·67; hydrogen, 3·16; marsh gas, 7·24; water, 25·34; and carbon, 1·82. The decomposition of gun-cotton under these conditions, which are similar to those of its explosion when employed as a destructive agent, appears, therefore, not to be attended by the production of any oxide of nitrogen. The lecturer found, in some preliminary experiments made under the same conditions as those of Karolyi, that only a minute proportion of binoxide of nitrogen was produced. These results, when compared with those obtained by the ignition of gun-cotton in open air and rarefied atmospheres, show that, just as the decomposition of this material is of a more complicated and intermediate character, in proportion as its combustion is rendered imperfect by diminution of pressure or other circumstances, so, conversely, the change which it undergoes will be the more simple, and its conversion into gaseous products the more complete, the greater the pressure, beyond normal limits, under which it is exploded—that is to say, the greater the resistance offered to the generated gases upon the first ignition of a charge of gun-cotton (and, consequently, the higher the temperature at which the decomposition of the confined gun-cotton is effected). It is, therefore, readily intelligible that the notions hitherto generally entertained with regard to the very noxious character of the products of explosion of gunpowder and their powerfully corrosive action upon metals, based as these notions have been upon the effects observed on exploding gun-cotton in open air, have been proved to be erroneous by the results of the actual application of gun-cotton to artillery and other purposes. The foregoing considerations contribute, moreover, to the ready explanation of the fact established by the experiments in Austria, that the destructive effect of gun-cotton is greatly increased, within certain limits, by increasing the resistance which the products of explosion have to overcome before they can escape into the air.

The conditions (of temperature, pressure, &c.) which influence the nature of the decomposition of gun-cotton, exert, unquestionably, a similar influence upon the nature of the explosion of gunpowder, and upon the mechanical effects which its products are capable of exerting. Observations made by the lecturer in experiments upon the ignition of gunpowder in rarefied atmospheres point to the existence of products of comparatively complicated character among those found by the gradual decomposition of that material, under the conditions described. The earlier investigators (Guy Lussac, Chevreul, &c.) of the products of explosion of gunpowder represent these as being of a very simple character, and in harmony with the theory that gunpowder is converted essentially by its explosion into carbonic acid (or a mixture of that gas and carbonic oxide), nitrogen, and sulphide of potassium. But more recent experimenters, Bunsen and Schischkoff, who have made a very elaborate examination of the products which they obtained by the explosion of gunpowder, represent the change to be one of a very complicated character; fix the percentage of solid substances found at a much higher figure than that hitherto accepted; and show that the sulphide of potassium, which has hitherto been considered as the principal of these products, was only produced in very small proportion in their experiments. The conditions under which these chemists exploded the gunpowder did not, however, correspond in their character at all to those under which gunpowder is exploded in actual practice, and would, therefore, be very likely to furnish results greatly at variance with those produced when a charge of powder is fired in a gun, a shell, or a mine. That sulphide of potassium is abundantly produced upon the discharge of a firearm appears beyond doubt; it may be readily detected in the solid matter which remains in the barrel near the breech; it may be found deposited in considerable quantity near the muzzle of the arm; and there appears strong reason for believing that the flash of flame observed at the mouth of a firearm, upon its discharge, is due in part to the ignition, as it comes into contact with the air, of sulphide of potassium, which has been vaporised by the heat of the explosion, and is thus mixed with the escaping gases.

In comparing the effects of gun-cotton, as an explosive agent, with those of gunpowder, and in basing theories with regard to the difference in the mechanical effects exerted by the two, upon the analytical results of the products of their explosion which have been obtained up to the present time, it is necessary to proceed with great caution; for exceptional results cannot form any sound basis for correct theories or tenable arguments. It can only lead to incorrect conclusions, which may considerably retard the thorough investigation of a most important subject, if the facts be ignored or lost sight of—that, firstly, the conditions which practically influence the nature of the products of the explosion of gun-cotton have a similar influence upon the changes which gunpowder may be made to undergo; and that, secondly, the effect of heat upon the water produced by the decomposition of gun-cotton, which forms so important an element in the action of this explosive, has most probably its parallel, to no unimportant extent, in the vaporising effect of heat upon the solids (especially upon sulphide of potassium) produced in the explosion of gunpowder. These are matters which demand their full share of consideration and investigation before it can be admitted that a sufficient explanation of the remarkable differences between the effects of gunpowder and gun-cotton exists in the assumption that certain products of decomposition of the former must be regarded entirely as waste matter in the material, simply because they are solid *at ordinary temperatures*. The fact that gun-cotton is *entirely* converted into gases and vapour *at the moment of explosion* constitutes unquestionably one of the great advantages which that substance possesses over gunpowder; but it is premature, at present, to assume, in comparing the action of the two substances, that only 32 per cent. (or even 60 per cent.) of gunpowder exist as gas or vapour *at the moment of its explosion*.

It is to be expected that the investigations which are now being actively pursued upon the true chemical effects produced in the explosion both of gun-cotton and gunpowder, under conditions similar to those which attend their employment in practice, will aid materially in furnishing the correct data so essential for a thorough and impartial comparison of the nature and merits of these two explosive agents.

ACADEMY OF SCIENCES.

May 30.

MM. **Bussy** and **Buignet** communicated a note in reply to the strictures of M. Blondlot on their "*Method of Purifying Sulphuric from Arsenious Acid*" (see page 225). They say that experiments have proved to them that ammonia has no reducing action on arsenic acid, and, consequently, their process is free from the objection brought against it by M. Blondlot.

MM. Daubrée and Cloez give a very interesting account of some "*Meteorites which fell in the Neighbourhood of Orgueil*" on the 14th of last month. The most curious fact mentioned by M. Cloez is that the stone he examined contained a notable quantity of chloride of ammonium, with chlorides of potassium and sodium and sulphates of magnesia and lime. Five per cent. of the stone, in fact, was soluble in water.

A note by M. Gal, "*On some Derivatives of the Chloride and Bromide of Acetyle*," describes the monochlorinated and monobromated chlorides of acetyle, and the monochlorinated bromide of acetyle.

A paper by M. Blondeau gave an account of the "*Action of Sulphuretted Hydrogen and Ammonia on Gun-cotton.*" The author considers the gun-cotton $C_{12}H_{10}O_{10}(NO_5)_3$ as a definite compound representing the ether of a triatomic alcohol, which can only be cane sugar $C_{12}H_{11}O_{11}$. He is confirmed in this notion by the behaviour of ammonia in regard to it. Gun-cotton fixes ammonia and forms a triamide, which, according to analysis, may be represented by the formula $C_{12}H_{10}O_{10}(NO_4)_3(NH_2)_3$, to which the author gives the name *cellulo-nitric triamide*. When treated with potash three equivalents of hydrogen in this compound are replaced by three of potassium, and when this compound is treated with a soluble salt of lead the other three equivalents of hydrogen are replaced by three of lead, and we have a *plumbo-potassic cellulo-nitric triamide*. The cellulo-nitric triamide also absorbs sulphuretted hydrogen and forms a *sulphide of cellula-nitrous triamide*—

$$C_{12}H_{10}O_{10}(NO_3)_3(NH_2)_3S_3.$$

A paper, by M. Maumené, entitled "*A General Theory of the Exercise of Affinity*," was presented. An abridgment would hardly convey an adequate idea of M. Maumené's theory, so we shall leave it for the present, with the remark that the principle the author seeks to establish is the following:—That the masses which really act in producing chemical action are determined by, and are proportional to, their densities.

M. Hugo Schiff made a communication "*On Some Derivatives of Ethylidene.*" The author describes two new series of bases and a host of derivatives, and the length to which his experiments were extended may be judged from the fact that he mentions having obtained the chloride of dimercurodiethylidenediphenammonium.

NOTICES OF BOOKS.

Manual of the Medicinal Preparations of Iron, including their Preparation, Chemistry, Physiological Action, and Therapeutical Use. With an Appendix containing the Iron Preparations of the British Pharmacopœia. By Harry Napier Draper, F.C.S. Dublin: Fannin and Co. London: Hardwicke. 1864.

This is a kind of book which we are happy to welcome and recommend. Numerically, the iron preparations form the most important class of remedies with which the pharmaceutist and medical practitioner have to deal. To the pharmaceutist they offer some difficulties, for their successful preparation often requires a considerable amount of skill and experience, and sometimes chemical knowledge. Very few can be safely prepared by merely putting the ingredients together, and following as nearly as possible written directions.

Take as examples the scaled preparations which have now become so numerous and popular. How many have succeeded in their first attempts at making any one of these medicines? A good deal, in fact, might be written on these preparations alone; and the only deficiency we notice in Mr. Draper's book is the want of practical information on this part of his subject. He leaves, in fact, the Pharmacopœia directions for Ferri et ammoniæ citras without the remark that the solution must first be evaporated to a proper consistence for scaling, or no scales will be obtained. We should have been glad to have had the author's experience with the Pharmacopœia process for Ferri et quinæ citras.

After these remarks we may express hearty approbation of both the matter and manner of Mr. Draper's book. It is an excellent manual, which we confidently recommend to pharmaceutists.

Annales de Chimie et de Physique. April, 1864.

The chemical papers in this number of the Annales have for the most part already appeared either at length or in an abridged form in the Chemical News, and one by M. Berthelot on the action of sulphurous acid on sulphur will appear shortly, as well as the conclusions at which M. Scheurer-Kestner has arrived in the course of his theoretical researches on the manufacture of soda by Leblanc's process. The memoir of M. Deschamp "On the Dried Capsules of the Papaver Somniferum" gives the particulars of his process for extracting *papaverosine*, the new body we mentioned a week or two ago. The author has not yet finished his study of this substance, and as yet gives no formula for it.

We see with pleasure the valuable paper "On the Estimation of Phosphoric Acid by Magnesian Salts," by Mr. R. Warington, jun., reproduced here, as well as other interesting matter from English journals. We notice, too, that in this, the first number of a new volume, the editors have adopted a plan similar to our own of giving the titles and sometimes abridgments of all the papers in foreign scientific journals. From these abridgments we shall often have occasion to borrow.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

949. John Milnes, Gloucester, "Improvements in fuel."—Petition recorded April 15, 1864.

1151. Andrew Barclay, Kilmarnock, Ayrshire, N.B., "Improvements in certain apparatus for injecting and ejecting fluids."—Petition recorded May 6, 1864.

1199. Otto Sachs, Aldermanbury, London, "Improvements in the manufacture of aniline dye colours."—A communication from Richard Froehling, Gesundbrunnen, Berlin, Prussia.

1200. John Phillips, Hatton, near Leeds, Yorkshire, "Improvements in the purification of coal gas, and in the application of the products resulting from such purification."

1205. Thomas Nesham Kirkham, West Brompton, and Vernon Francis Ensom, Highgate, Middlesex, "Improvements in cleaning, bleaching, and dyeing woven fabrics and piece goods."—Petitions recorded May 12, 1864.

1228. Alfred Fryer, Manchester, Lancashire, "Improvements in treating animal charcoal in the process of revivification, and in apparatus employed therein."—Petition recorded May 14, 1864.

1232. Joshua Womersley, Norwich, "Improvements in the manufacture of paper from certain fibrous substances."

1234. William Reid, Adelaide Road, Haverstock Hill, Middlesex, "Improvements in apparatus used for testing the insulation of electric telegraph wires or conductors."—Petitions recorded May 16, 1864.

1236. William Wilson, Manchester, Lancashire, "Improvements in, and apparatus for, generating gas from hydro-carbon or other volatile oils for illuminating and other purposes."—Petition recorded May 17, 1864.

1252. Richard Smith, Glasgow, N.B., "Improvements in obtaining colouring matters."

1254. John Bilby Merrikin, Bath, Somersetshire, "Improvements in bottles or vessels for containing poisons."

1258. James Webster, Birmingham, Warwickshire, "Improvements in the manufacture of zinc."—Petitions recorded May 18, 1864.

1262. Thomas Dunlevie, Dublin, Ireland, and John Jones, Liverpool, Lancashire, "Improvements in metallic alloys."

1270. Joseph Freeman, Edward Grace Freeman, and Charles Henry Freeman, Bridge-road, Battersea, Surrey, "Improvements in treating oil and spirit varnishes, and also drying oils and turpentine in order to bleach and otherwise improve the same."—Petitions recorded May 19, 1864.

Notices to Proceed.

164. James Turner Hall, Edgehill Station, Liverpool, "An improved combined lantern and lamp for burning petroleum and other like hydro-carbon fluids."—Petition recorded January 21, 1864.

194. Thomas Bright, Carmarthen, "Improvements in kilns and apparatus for drying malt, corn, hops, and other vegetable substances."

196. John Platt and William Richardson, Oldham, Lancashire, "Improvements in the preparation of clay for the manufacture of bricks, tiles, slabs, or other articles which may be made of such material."

200. Eugen Lucius, Frankfort-on-the-Maine, Germany, "Improvements in the manufacture and production of colours."—Petitions recorded January 23, 1864.

203. William Ibotson, of Wraysbury, Buckinghamshire, "An improvement in the process of bleaching materials for paper-making."—Petition recorded January 25, 1864.

226. Johann Zacherl, Vienna, "An improved tincture or liquid preparation for destroying insects."—Petition recorded January 27, 1864.

937. Thomas Stevens, Glasgow, and Charles Batty, London, "Improvements in arrangements and apparatus for ventilating, for protecting from heat, and for heating and cooking."—Petition recorded April 14, 1864.

CORRESPONDENCE.

Patent Law.

To the Editor of the Chemical News.

Sir,—It is a fact of every-day occurrence that lawyers convert or pervert facts into anything suitable for their purpose, however widely different they may be intended to the construction put upon them. In the case of "Young v. Fernie" many instances occur; take my own examination. I had prepared oils containing paraffine from cannel and other coals, shales, bituminous sand-stone (swine-stone), and petroleum, from the year 1845—five years, at least, before Young's patent in 1850—and had offered them in the market during those years, and had sold a considerable quantity as naphtha and burning oil and also for lubrication, and a portion thereof to Mr. Parkes, specially for preparing paraffine therefrom, as you will observe by his evidence (26th day, p. 9), which is not attempted to be denied; and I had also separated paraffine therefrom myself, and, further, I had obtained similar oils to Mr. Young from the so-called Boghead coal in October, 1849, twelve months before his patent; but because I was so situated that I could not obtain that article upon reasonable terms, owing to my distance therefrom, and I was not prepared to go to the Boghead and the cannel of my own neighbourhood, being an irregular production, obtained only occasionally, I am called an unsuccessful manufacturer, according to the judgment of Vice-Chancellor Sir J. Stuart, and who, to make my failure more apparent and complete, calls to his aid "the order of withdrawal of my samples from the Exhibition of 1851 on account of their quality and offensive smell," whereas they had not been examined, and the cause of their being withdrawn was on account of their being with some samples of bisulphide of carbon, chloride of sulphur, &c., the stopper of the bottle containing the last article having become loose from mishap or inattention by my agent, and this, I think, you will consider a good cause of complaint, knowing the article; but it pleased the Vice-Chancellor to apply the cause of withdrawal to the oils, which was unjust.

In drawing a just comparison between the oils I produced and those of Mr. Young it should not be overlooked that Mr. Young was very far from perfecting his oil even up to 1857, and then the smell was very objectionable to most people, and remains so even to this day; and further, the oils offered for sale by him in the early years of his patent were not coal oils, but mixed oils, and consequently the smell would not be so strong as pure mineral or coal oil. Upon reference to Mr. Poynter's evidence (twenty-sixth day, page 20) you will observe that, from 1853 to 1856 Mr. Young only obtained 6d. per gallon for his burning oil, and that "*it had not a pleasant smell.*" During this time I was obtaining for what I sold prices ranging from 1s. to 7s. per gallon, showing a state of purity superior to Mr. Young. The latter I sold to Mr. Bailey, of Wolverhampton, in 1854, for the preservation of potassium and sodium. Unfortunately I could not obtain materials to work upon regularly, but of late years I have sold an oil for burning superior to Mr. Young's for burning qualities, colour, and smell. This was not referred to in my evidence, being mostly confined up to the years 1851-52, when I made a series of experiments for Mr. Clift, agreeable to his own wishes, and which had nothing whatever to do with my previous workings of 1845 to 1851.

Mr. Grove (thirty-third day, page 17) thinks if my claim was just I should have written to the *Gas Journal* or some other public paper on the subject. Allow me to say I am not very partial to bringing my claims or name before the public. I have suffered severely through patents, and have no desire to possess them, being well aware that uneasy lies the head that owns one; and I have anything but a predilection in favour of law or lawyers.

I have written this simply to correct some of the statements of the Vice-Chancellor. I am, &c.,

Jesse Fisher.

Ironbridge, June 4, 1864.

Safety Matches.

To the Editor of the Chemical News.

Sir,—About two years ago you favoured your readers with a notice of the then newly introduced Patent Safety Matches, and partly in consequence of your announcement I was induced to forbid the purchase by my household of the old phosphorus matches. From that time I have continued to use the matches requiring a special friction-surface for their ignition, and have always been supplied with those sold under the above name, or with the "Imperial Safety Matches." I have, however, lately remarked an objectionable peculiarity to which the latter seem especially liable. It is, that at the moment of ignition a dense white cloud of volatilised metallic compounds escapes into the atmosphere, which makes itself at once apparent by the nauseous flavour and odour diffused in the apartment. The lighting of a single match is enough to pollute the atmosphere of a small room, and for bed-chamber lights I find it impossible to continue their use.

I have made a few analytical experiments for the purpose of arriving at the primary cause of the objectionable property now complained of, and find, in the first place, that the match composition is applied so liberally to the head of the wooden splint, that from sixteen of the latter matches I removed not less than ten grains of the combustible material; and on further examining this, I discovered that it contained a very large proportion of the grey sulphuret of antimony, besides a quantity of brown oxide or some other compound of lead. In the presence of the oxidising agents commonly employed in the making of matches, it is well known that these metallic substances on ignition give off poisonous vapours; and, when burnt in large quantity, as in the Bengal signal lights, it is always necessary to inflame them in the open air, so as to avoid inhaling the fumes of lead and antimony.

Many of the cheap cigar-lights also contain large quantities of these deleterious ingredients; and believing that the fault requires only to be pointed out in order that it may be practically overcome, I am, &c., S. J.

June 6.

MISCELLANEOUS.

Conversazioni at Apothecaries' Hall.—On Tuesday, May 31, the Master and Wardens of the Society of Apothecaries gave a brilliant microscopical *conversazione* at their Hall. Most of the noted makers of microscopes sent instruments, and a large number were contributed by private and professional gentlemen. The noble hall was hung with diagrams illustrative of comparative anatomy, and in the library a number of botanical diagrams and dried plants were suspended. In the board-room, darkened for the occasion, Mr. Atkinson showed the rotation of the electric spark around a magnet in a vacuum. This is a beautiful experimental illustration of Faraday's well-known discovery, devised by Rhumkorff. In the same room the Messrs. Wheeler showed some interesting experiments in electrolysis, and illustrated the allotropic conditions of several elements. One of the experiments was the electrolysation of water by means of carbon poles, in which carbonic acid is obtained at the negative pole in place of oxygen. Of this experiment we shall give a further account. On the Wednesday morning the same gentlemen made a series of brilliant experiments with twenty-four cells of a carbon battery constructed by themselves. With this battery they produced a powerful electric light, and exhibited the arc of the thallium flame on a screen. Iron and zinc were burned with the same battery. Mr. Ladd attended on both occasions with his vacuum tubes Besides the microscopes, a number of other scientific instruments were displayed. Messrs. Spencer Browning and Co. showed spectroscopes. Messrs. Murray and Heath showed a polarising apparatus and a stereoscope on a new principle. Mr. How exhibited, besides microscopes, an electromotive machine in action, with an ingeniously-contrived regulator; he also showed the fluorescent properties of a solution of sulphate of quinine by means of a vacuum tube in a large glass dish of the fluid. The *conversazioni* were very numerously attended (by gentlemen in the evening and ladies in the morning), and the company seemed to derive great gratification.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

A Frenchman.—Received.

A Reader.—Solution of potash.

A Student.—1. Write to Dr. Redwood, the Secretary. 2. Write to Mr. Trenham Reeks, School of Mines.

J. A. M. and Co.—An answer by post.

Received.—W. S. Gossage.

Book Received.—"Dictionary of Chemistry," Part XVI.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

The Detection, Distinctive Characteristics, and Estimation of Natural Organic Alkaloids, by M. Alfred Valser.

[The following notice of a recently published thesis will probably supply our readers with a few useful hints on the subject of which it treats.—Ed. *C. N.*]

The thesis is divided into three parts. The first gives the means for filling up the hiatus in Stas's process for morphine, and indicates a general reagent for alkaloids. The second part treats of the reactions peculiar to each. The third part concerns the determination of their equivalents.

In the first part of his paper M. Valser clearly shows the insufficiency of Stas's process, an insufficiency already pointed out by MM. Lefort and Reveil relative to the detection of morphine in poisoning cases. Being insoluble in ether, morphine could not be obtained free by that method. The author has endeavoured to substitute for common ether a solvent capable of obviating this inconvenience. This substitute he has found in acetic ether, which dissolves morphine at least as well as alcohol. After devising a method for rectifying commercial ether, he makes use of this solvent in the following way:—

The substances to undergo examination having been treated as far as possible by Stas's method, he adds to the residue already exhausted by ordinary alcohol a certain quantity of potash and acetic ether, which take up any morphine there may be remaining. On evaporating separately the simple etherised liquid and the acetic ether liquid, the morphine left in the residue left by the latter is recovered, all other vegetable bases being included in that which furnished the simple ether. At this point it is necessary to ascertain whether these residues are indeed the alkaloids. Their usual reagents, such as tannin, chloride of gold, iodised water, phosphomolybdic acid, &c., not being exempt from drawbacks, the author prefers the reagent used by M. de Vry in researches on atropine and strychnine; that is to say, double iodide of mercury and potassium. M. Valser finds it possesses the invaluable property of entirely precipitating alkaloids, it being so exquisitely sensitive to their presence as to indicate $\frac{1}{100000}$ of strychnine in a liquid. Moreover, this double iodide precipitates none of the other principles contained in the vegetables, except the albuminoid matters; but the presence of these matters is not encountered, since they are eliminated by the ether in Stas's process.

These facts once admitted, the author makes use of this reagent, whose general utility and sensibility are incontestible, to establish the presence of alkaloids in oils of belladonna, hemlock, &c., which before was only suspected.

The second part is devoted to researches on the distinctive characteristics of alkaloids. Finding the most characteristic reactions on these matters produced by oxidising bodies, the author tried each of them successively at various temperatures; sulphuric acid alone or associated with binoxide of barium or binoxide of lead; hydrochloric acid with binoxide of barium; chloride of gold and caustic potash. With each be elicited distinctive characters.

The third part comprises a study of the estimation of alkaloids and the determination of their equivalents. "Observing with what facility the solution of double iodide of mercury and potassium detected the least trace of alkaloids, the author was induced to examine whether the resulting combination could be exactly defined, and whether be could obtain a precipitate invariable in weight and characteristic of each of them." Such, in effect, is the result he obtained whilst experimenting on a certain number of vegetable bases. The high equivalent of the reagent employed, the great density of the alkaloid precipitates, their insolubility in aqueous liquids, even when acidulated, enabled him easily to determine, not only the composition of these precipitates, but the equivalents of the alkaloids themselves.

This new method leads M. Valser to conclude that we must revert to the old equivalents for quinine and cinchonine, which are but half those since adopted. He also found by the same means that quinidine is isomeric, not polymeric, with quinine.

The author desired to apply his reagent for the estimation of vegetable alkaloid matters, but the presence of albuminous and extractive principles vitiated the results. Further, perceiving that the processes used in these researches, besides being insufficient, occupied too long a time, he successfully modified them by combining the successive action of the proper solvents in presence of lime, which isolates the alkaloids, and of tannin, which assists in decolorising the liquids. This process, too long to be here described, greatly shortens the operation, and isolates purer products.

Such is the summary of M. Valser's paper. He has not feared to attack excessively delicate toxicological and chemical questions. Without diminishing the precision of Stas's process, be has, by extending it, rendered it applicable to the research of morphine. He has generalised a valuable reaction to isolate alkaloids by employing double iodide of mercury and potassium, which precipitate them so effectively. This reagent has demonstrated the presence of some vegetable bases in certain medicinal oils. He has besides discovered some new reactions for distinguishing the principal organic alkalies one from another. Then proceeding methodically, be utilised the valuable iodhydrargyrate of potash for the rigorous determination of the equivalent of alkaloids, rectifying some, changing others, all deduced from numerous correct and unexceptionable analyses, and finally crowned all by planning a general process for the estimation of all matters containing alkaloids.—*Journal de Pharmacie et de Chimie*, xliii., 49, 63.

TECHNICAL CHEMISTRY.

On Aniline Black.

Whether aniline black exists or not is a question, notwithstanding the patents which have been taken out for its production.

As to a black colour so long desiderated, that is to say, a colour capable of general application to every kind of fabric, there is no such thing as aniline black,—belief in its existence is but a passing delusion.

We notice this subject in the hope of stimulating inquirers to fresh experiments and researches which may overcome the difficulties now opposing the extended application of this colour, remarkable as much for its beauty as for the curious reactions which produce it.

At present its application is extremely limited, and besides it is subject to so many inconveniences and irregularities that some of the first manufacturers have provisionally ceased to employ it.

In the fabrication of aniline violet by bichromate of potash (Perkin's process) there is obtained, besides a very small quantity of violet colour, a large quantity of a black (resinous?) mattor,* combined or mixed with sesquioxide of chromium, resulting from the reduction of chromic acid. Attempts have been made to use this black for printing black or grey, fixing it on the stuffs by albumen, but the tints not equalling those of carbon it has been abandoned. It seems that these residues will now be used for regenerating chromic acid.

This idea of applying the residue to printing stuffs was the first step leading to a process for effecting the reaction on the tissue itself, on the fibres which the residue (in this instance the useful matter), would become precipitated, and fixed almost indelibly.

On the other hand, M. Emile Kopp first, I believe, then MM. Gerber Keller and Crace Calvert, some years ago, showed that slightly acid solutions of aniline salts, mixed with a solution of chlorate of potash or soda, gave, by moderating more or less the action of the chloric acid, a great number of tints, from light green to greenish black. These tints are obtainable with equal facility on stuffs impregnated with a mixture of the two solutions, as in the liquid itself.

About eighteen months ago the English house of Lightfoot obtained a patent in England and France, for the application of an aniline black by the process described further on. This patent was purchased by a Swiss house, to be carried out in both countries.

Aniline Black.

Water	6 litres.
White starch	850 grammes.
Chlorate of potash	180 ,,
Dry hydrochlorate of aniline	450 ,,
Sulphate of copper	180 ,,

Stuffs printed with this preparation should be exposed for three days in a hot, moist, oxidating chamber. At first extremely faint, the colour gradually deepens to black, when, after two days' exposure to the air, the fixation of the dye may be hastened by steaming the pieces. We believe, however, the latter process may weaken and even seriously deteriorate the tissue.

An experienced chemist will, at first sight, perceive one great drawback to the process—the large amount of copper entering into its composition. In fact, in roller printing scrapers or plates of steel are used; now these scrapers are rapidly attacked by all the colours into which even a small quantity of salts of copper enter, and in order to produce a distinct impression and to avoid soiling the other colours and the parts of the tissue which should remain white, the printer is obliged to constantly renovate the scrapers with file and stone to restore to them the necessary edge and polish. All this entails great loss of time, and an irregular and defective impression.

This inconvenience has been obviated by preparing the material with a solution of salt of copper instead of adding it to the colour. But the application of aniline black is by this means much limited, as there are very few colours which can be printed on materials thus prepared; and now-a-days processes are required by which four, five, seven, ten colours can be simultaneously employed.

The preparation of stuffs by bichromate of potash has also been tried, but we are not aware that any favourable results have been obtained. We should imagine that a less vivid and less velvety black would be the result, for in general all colours containing sesquioxide of chromium in notable quantity are dull and earthy.

Mulhouse's Process.—Some months since a manufacturing firm at Mulhouse believed they had found a process, which, if not infallible, was much superior to the English process. It was also patented, and the patent sold to the same Swiss house which bought the English patent.

A notable progress is made in this new process, but it is still far from realising the expectations formed on its first announcement.

The process is as follows:—

Thickening.

White starch	27 kilog.
Water	18 litres.
Gum water, 1 kilogr., 200 per litre	30 ,,
Tragacanth gum water, 65 gr. per litre	24 ,,

Digest these.

Preparation No. 1.

Hot thickening.	25 litres.
Chlorate of potash	1·350 kilog.
To which is added when cold ferricyanide of ammonium	3·900 ,,

Preparation No. 2.

Hot thickening	26 litres.
Dry powdered hydrochlorate of aniline	3·600 kilog.
Tartaric acid	3·750 ,,

For the colour for printing stuffs take—

No. 1	1 part.
,, 2	2 parts.

The following difficulties and inconveniences attending the application of aniline black must be either conquered or surmounted:—

1. These two colours, whose preparation we have given, are subject to rapid decomposition, the second much more so than the first.

2. The oxidation or the formation of the black takes place irregularly. To produce adequate regularity, it is necessary to study exactly the temperature and humidity of the oxidising rooms, as well as the time the material should remain there.

3. To find a means of terminating the reaction, or formation of black on the stuffs, or removing the still unfixed products before the pieces are finished, for if the colour works (as it is called) after the material is considered ready for sale, unequal tints and, consequently, damaged goods will be the result.

4. To prevent the aniline colour mixing with other colours, and attacking them in roller printing, where several colours ought to touch without injuring each other or mixing, and especially to prevent a slight running which destroys the clearness of outline, and is a more serious fault with black than with any other colour.

5. Finally, what in many cases is a most valuable quality becomes a fault with aniline black—its fixity, its indelibility. No reagent is yet known which will entirely destroy this colour. It resists even two or three entire bleaching operations; hence some chemists are of opinion that it is carbon reduced or isolated from aniline. However, salt of tin (stannous chloride) will partially decolorise and destroy it.

In printing factories pieces of unbleached calico, doubled, are used to preserve the woollen cloths in the printing tables and printing machines. These calicos become impregnated with the whole mass of colours used in printing white stuffs. These doubled cloths are afterwards bleached, and become as white as if they had never been applied to such a purpose. This is unfortunately not the case with aniline black, which, as we have already said, resists bleaching. There are also spots, splashes, marks of scrapers, &c., unavoidable in printing factories; there is no means of getting rid of these, and the manufacturer has damaged pieces. — *Moniteur Scientifique*, vi., 433.

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* This black matter is also obtained by preparing the violet by hypochlorite of lime, in which case it is naturally free from oxide of chromium.

Manufacture of Fatty Acids for Candle and Soap Making, by M. H. MEGE-MOURIES.

MY researches on amylaceous grains, especially wheat, have furnished the means of substituting for brown bread, in Paris, a cheaper and more nourishing kind.

Analogous studies on oleaginous grains have altogether modified the economical conditions of two great manufactures. I will proceed at once to the results.

In oleaginous grains during germination, as in the animal economy during life, neutral fats pass, before undergoing any other modifications, into the state of very mobile globules, presenting a very large surface to the action of reagents.

In this globular state fatty bodies manifest peculiar properties; we will mention those directly connected with the subject of this memoir.

1st. A fatty body in the ordinary state—suet, for instance—quickly becomes rancid by exposure to damp air; in the state of globules, on the contrary, it will keep for a long time, either liquid or dry, and as a kind of white powder (I possess specimens prepared in June, 1863).

The globular state may be produced by yolk of egg, bile, albuminous matters, &c.; for industrial purposes, it is produced by mixing tallow, melted at 45°, with water at 45°, holding in solution from 5 to 10 per cent. of soap.

2nd. Tallow, in the ordinary state, like other fatty bodies, resists washings in hot soda ley, and combines with it only with very great difficulty; in the globular state, on the contrary, it immediately absorbs this washing, in quantities varying with the temperature, so that it is possible, so to speak, to distend and contract each globule by lowering or raising the temperature between 45° and 60°.

It is easy to understand that in this case each globule of the fatty matter, attacked on all sides by alkali, abandons its glycerine with such rapidity as speedily to produce a liquid in which each globule is a perfect soap globule, inflated with lixivium. This can be effected in two or three hours.

3rd. These saponified globules, when exposed above 60°, gradually reject the lixivium with which they were distended, retaining only the quantity of water always entering into the composition of soap. They then become transparent, semi-liquid, and their confused mass forms a layer of melted soap above the lixivium, which retains the glycerine.

4th. The saponification of this mass is so complete that to extract the stearic acid it is only necessary to dilute the soap in cold water, and acidulate with a quantity of sulphuric acid proportioned to the soda. The fatty acids, mixed with water charged with sulphate of soda, may be separated by melting and pressing when cold, to obtain stearic acid, inodorous and fusible at from 58° to 59°, and almost colourless oleic acid.

These results, tested by industrial experience, recall the time when M. Chevreul, after his remarkable investigation of fatty bodies, believed that stearic acid could be economically produced with oleic acid. Unfortunately, all attempts to carry out this idea have failed.

Thus lime has been employed, the soap of which decomposes only by very strong measures, giving rancid, coloured oleic acids, whilst producing a loss in the deposits of sulphate of lime, without counting a number of costly operations; then came distillation, which increased the loss from 10 to 15 per cent., and lowered the value of the product, so much that one part of stearic acid disappeared and the oleic acid was rejected on account of its odour, its colour, and its inapplicability for making an agreeable soap; then came the splitting up of the fatty body by water under pressure; but then the incomplete saponification and diffused crystallisation became an obstacle to all subsequent operations. Finally, instead of pure water, a small proportion of lime, soda, or soap was put in the digester. The saponification still remained incomplete; the decomposing and pressing operations gave the same results in this as in the preceding instances, yielding only a kind of stearic acid, with a very low fusing point, and a red oxidised oleic acid to the value of 85 or 88 frs., while the olive oil was worth 130 and 135 frs. (These various operations have been described by MM. Peleuze, Tilman, Melsens, Podwer, &c.)

In the new operation all this is reversed; the loss is *nil*, being limited to the subtraction of the glycerine; the quantity of fatty acids obtained is 96—97 per cent. The operation is carried out in a single day; thus, operating on 2000 kilogrammes, three hours are required for the saponification, one hour for the decomposition, three hours for the fusion and settling, for the crystallisation eight hours, for pressure when cold in a double press four hours, making altogether nineteen hours for the operation; and as the crystallisation takes place in the night, there is in effect only eleven hours' work.

By this simple method we effect not only great economy in labour, fuel, and product, but also, thanks to the lowness of the temperature throughout, we obtain an inodorous, unaltered stearic acid, fusible at 58°—59°, and an oleic acid, equal, if not superior, to the best oils used in soap making.

It is obvious that this manufacture is revolutionised. Fatty bodies are now treated to produce stearic acid, leaving oleic acid as residue; in future, the same fatty bodies will be treated to obtain oleic acid, and the price of stearic acid will be lowered by the value of the oleic acid obtained.

Thus M. Chevreul's prognostications will be realised, and the products of France, where this manufacture originated, will no longer be inferior to those of foreign countries.

Soaps.—The best white soap may be made from pure oleic acid, either alone or mixed with other oils. None but neutral oils can be used, such, for instance, as are now used for Marseilles soap. In the first case—that is to say, when oleic acid only is used, the glycerine being removed—it suffices to saturate this acid by a feeble washing. The soap globules form immediately, and no delay is required before fusing them. On the contrary, when oleic acid is mixed with other oils, or when only neutral oils are employed, the process described for suet is used. The fatty bodies are converted into the globular state, the globules being kept in motion by a hot and salt lixivium until complete saponification. The saponified globules are separated by fusion, the soap is melted, separated from the lixivium, and poured into the moulds, where it solidifies by cooling. The operation requires six hours' effective work, and in twenty-four hours a soap is obtained as perfect, as neutral, and lathery as old Marseilles soap. (The specimens of silk presented to the Academy had been comparatively treated at the Gobelins manufactory with Payen's white Marseilles soap more than eight months old, and with soap made only three days by the process above described.) Saving of time is not the only advantage of this process. It is obvious that each globule, being separately attacked both inside and out, without becoming agglomerated or cooked *en masse*, no portion escapes saponification. Moreover, caustic soda, acting at a medium temperature, does not alter the fatty bodies, as in the ordinary processes, in which part of the oils is carried off in the coloured and frothy lixivium, thus entailing a notable loss.

It results, then, that in twenty-four hours a soap can be made, in greater quantities, as pure, as neutral, whiter, and lathering better than the best white Marseilles soap, requiring for its manufacture thirty or forty days, and then kept several months. These researches I hope will tend to check the introduction of a host of injurious products sold under the name of soap to the injury of the needy population; and I further hope that the manufacture of soaps and of stearic acid may be raised from the comparatively present low state into which it has fallen.—*Comptes Rendus*, lviii., 864.

PHYSICAL SCIENCE.

Cohesion Figures of Liquids by Submersion.

In the current number of the *Philosophical Magazine* Mr. Tomlinson has introduced a new set of figures under the above title, formed, not by placing a drop of the liquid on the surface of water, as in his former experiments (Chemical News, vol. ix., pp. 79 and 96), but by allowing the drop to sink below the surface before the figure is developed. In this way a large number of figures of great variety and beauty have been produced by allowing drops of various oils, solutions, and other liquids to subside in columns of water, spirits of wine, ether, turpentine, paraffine oil, benzol, and pyroligneous ether. For example, a solution of cochineal (from 20 to 40 grains in one fluid ounce of distilled water and filtered) forms admirable figures in a column of water contained in a glass cylinder eleven inches high and three inches in diameter, into which about half an ounce of solution of ammonia or a little alum water had been poured. If river water be used the lime is thus thrown down, so that the water should be allowed to stand a few hours before performing the experiment; or if distilled water be employed, the ammonia and the alum, by their chemical action on the cochineal, add to the beauty of the result. As soon as the drop of cochineal solution (delivered gently from a pipette) falls beneath the surface, it expands into a ring, sinks a short distance further, and then becomes poised. The more diffusive portions of the colouring matter stream upwards in a faint flame-like circular cloud; the denser portions accumulate at two opposite points of the ring, which is thus at its thinner portions bent upwards, and then drawn downwards into graceful festooned lines by the heavier portions, which form separate rings smaller than the parent ring. These rings, in like manner, descend. The denser portions of colouring matter accumulate at the two opposite points, 90° from the points of attachment to the festooned lines. Each small ring is, in this case, also bent upwards, while it drops two other rings, which in their turn go through the same series of changes, until the figure becomes almost too complicated to follow. This is a very common result with a moderately weak solution of cochineal. With a stronger solution the figure undergoes some beautiful modifications. The heavier portions of the colouring matter collect not at two, but at four, six, or even seven or eight points of the ring, bending it upwards in as many curved lines, and letting drop as many rings, each of which becomes the seat of manufacture of two rings; and in this polypus method of division and subdivision the colouring matter is diffused through the solution.

A more complicated figure, on the above type, is formed by allowing a drop of oil of lavender (from the end of a glass rod) gently to subside beneath the surface of spirits of wine contained in a cylindrical glass six inches high and one inch and a quarter in diameter. Oil of cubebs or of cinnamon forms good figures. The oils of turpentine and of juniper, as well as fixed oils, form flat spheroids. The appearance of the figures depends upon the solubility of the liquid employed. In some cases they are glassy or saccharine, in others chalky or milky, arising from the elaiopten of the essential oils being first dissolved, while the stearopten is left to do the work of the figure. When a column of benzol was used, many of the essential oils formed these opaque white figures. Oil of winter-green, turpentine, camphorated spirit, oil of bitter almonds, &c., formed good figures; the fixed oils formed discs with waving edges or cup-shaped vessels, which became drawn out in descending. In a column of paraffine oil some remarkable figures were produced with absinthe, neroli, and fousel oils. With the last-named oil the drop first forms a disc hagging downwards, and this almost immediately expands upwards, swells out into a dome or cone, the ring expanding all the time; the point of the cone remains fixed in the liquid, while the lower edge becomes arched at four equidistant points, the edges of the arches beautifully fringed, and lets fall lines with drops at the ends, which form separate cones, each of which becomes arched, and lets down other lines with drops. In this way a figure is produced of great beauty, and with an architectural kind of effect which is very striking. The duration is also considerable. The texture of the figure is gauze-like and delicate. A number of figures were obtained when a column of turpentine was used; a still larger number in a column of pyroligneous ether, some of which were chalky and very persistent. A drop of water flashed into a ring, descended, and expanded in rolling on its curved axis somewhat after the manner of a bubble of phosphuretted hydrogen bursting in air. In a column of ether those drops that did not immediately enter into solution formed beautiful rolling rings,—this was the case with drops of benzol and of the oils of turpentine and cajeput.

These liquid rolling rings led to an investigation of the phosphuretted hydrogen rings in air, which the author thinks have not been correctly explained in our text-books. The nearest approach to a correct explanation is that given by Professor Rogers in the *American Journal of Science* for September, 1858; but his explanation, which is not very precise, is embarrassed by conditions depending on the form of the orifice of the vessel from which the ring was projected, the tension of the enclosed gas, the chemical action, and, in the case of a liquid ring, the force with which the liquid is projected into a column of water, &c. Very fine liquid rings can be formed by allowing a saturated solution of common salt or of Epsom salts to drop slowly into a tall column of water from a height of about two inches.[*] The liquid rings thus formed roll rapidly round their curved axes, and go on expanding nearly to the bottom of the vessel before they disappear. Two ionic-like volutes are seen on either side of the rings; these are produced by the perspective of a number of rings seen through, or nearly through, each other, while at the front and back the edges of single rings only are seen. The formation of these rings is thus explained:—

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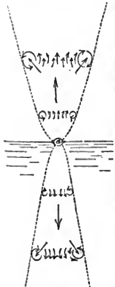
[*] The funnel containing the solution should be supported over the vessel, and the required slowness in the falling drops may be ensured by two or three folds of filtering-paper, or by first putting some of the salt into the filter.

"In the case of a liquid ring the forces are—(1) diffusion, which forms the ring; (2) gravity, which causes it to sink. The resistance is friction retarding (1) the descent of the ring, (2) its diffusion. In the case of a ring of smoke, the forces are precisely the same, only gravity causes it to ascend, and friction retards the ascent. I have attempted to combine both cases in the figure, where the globule *a* may be either a bubble of PH_3, about to burst and project a ring of smoke into the air, or it may be a drop of liquid about to descend in water, benzole, ether, &c. The ring of smoke, or the liquid ring, acts as if rolling up or down the inside of a hollow cone, and the direction of rotation of the particles will be found according to this view. In both cases the tendency of the ring is constantly to enlarge by diffusion, and the rate at which it does enlarge is regulated by the resistance of the liquid column or of the air. The resistance of the liquid column is much greater for the liquid ring than of the air for the smoke ring; and hence the liquid rings do not expand much, while the smoke rings expand greatly. But the resistance, whatever its amount, must clearly be applied to the outer surface of the ring; or the ring may be said to bear on the surrounding medium by its outer surface, which would be equivalent to its rolling up the inner surface of a hollow cone. In the figure, the straight vertical arrows show the motion of the ring up or down, the oblique arrows give the direction of the resultant of the forces acting on the ring, and the direction of the resistance of the medium to this resultant, while the curved arrows show the direction in which rotation must occur according as the general direction of the movement of the rings is upwards or downwards."

Air Ring.



Liquid Ring.

Aerial rings on a grand scale may sometimes be seen from a factory chimney, the funnel of a steamboat, or the chimney of a locomotive. A friend writing to Mr. Tomlinson says:—

"As I was watching a goods train on the line last evening making its way with difficulty up an incline, the engine suddenly shot out from the funnel a beautiful ring of rippled smoke and steam, which separated itself from the general cloud of steam coming from the funnel and rose in the air unbroken and distinct. It was visible until it had gained a height of fifty feet or more. I was too far off to see its rotation; the ring, however, was admirably clear, and kept its form and size unchanged until it became invisible from condensation. We have had frequent rifle practice, but I have not seen a ring made yet from the smoke of the gunpowder."

Investigations on the Specific Heat of Solid and Liquid Bodies, by HERMANN KOPP, *Ph.D.*[*]

THE author commenced this paper with an historical report, giving a complete analysis of the various opinions already published on the subject. He then proceeded to describe the method he has used for determining the specific heat of solid bodies. This method is based on the method of mixtures. The substance investigated is placed in a glass tube, together with some liquid which does not dissolve it, and the tube is heated in a mercury bath, and then rapidly immersed in a calorimeter containing water. Equalisation of temperature takes place rapidly through the intervention of the liquid in the tube. The thermal effect (increase of temperature in the water of the calorimeter) is determined. Preliminary experiments give the means of allowing for the thermal effect due to the glass and to the liquid in it, and of thereby obtaining the thermal effect produced by the solid substance. The entire method (of which we hope to give a full account) is very simple, and it brings the determination of specific heat out of the restricted sphere of the physical cabinet, with its complicated apparatus, within reach of the ordinary appliances of the chemical laboratory. It is also applicable to small quantities, and to such substances as cannot bear a high temperature.

The author then gives his determinations of a very great number of solid bodies whose specific heat had not been previously determined; they extend to all the more important classes of inorganic compounds, and to a great number of organic compounds.

In the fourth part the author gives for solid bodies of known composition the atomic formula, the atomic weight, the more trustworthy determinations of specific heat, and, corresponding to these, the atomic heats, or products of the specific heats and the atomic weights.

The relations between the atomic heat and the atomic weight, or the composition, are next discussed, preceded by a discussion whether the specific heat of a body varies materially with its different physical conditions. The influence which change of temperature of solid bodies exerts on the specific heat is considered. This difference is inconsiderable, as is also the difference of specific heats found for the same substance, according as it is hammered or annealed, hard or soft. With dimorphous varieties of the same substance, even where the specific gravity is different, the same specific heat is found in most cases. Great difference had been supposed to exist in the specific heat of a substance, according as it was crystalline or amorphous. Dr. Kopp shows that, for a great number of substances, there is no such difference, and that in other cases the apparent differences depend on inaccurate determinations of the specific heat. He shows also that three sources of error may give too great a specific heat for a substance, or for one of its various modifications:—

1. When the substance is heated to a temperature at which it begins to soften, and thus to absorb part of its latent heat of fusion.

2. If the substance is heated to a temperature at which it begins to pass into another modification; and

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[*] Abstract of a paper read before the Royal Society, May 12, 1864.

this change, with its accompanying development of heat, is continued in the calorimeter.

3. If the substance investigated is porous, and (as was the case in the earlier methods) is directly immersed in the liquid of the calorimeter, in which case the development of heat which accompanies the moistening of porous substances comes into play.

The author arrives at the following results:—From what is at present known with certainty, one and the same body may exhibit small differences with certain physical conditions (temperature, or different degrees of density or porosity); but these differences are never so great as to furnish an explanation of cases in which a body markedly deviates from a regularity which might perhaps have been expected for it, always assuming that the determination of the specific heat, according to which the body in question forms an exception to the regularity, is trustworthy and free from foreign elements.

The author then discusses the applicability of Dulong and Petit's law. The atomic heats of many elements† are, in accordance with this law, approximately equal; they vary between 6 and 6·8, the average being about 6·4. The explanations attempted why this law only approximately holds good, he considers inadequate. In any case there are individual elements which do not obey this law. The atomic heat of phosphorus, for instance, as deduced from direct determinations of its specific heat in the solid state, is considerably smaller (about 5·4), and still more so are those of silicium (about 4), of boron (about 2·7), and of carbon (1·8 for diamond).

A regularity, to which attention has been already drawn, is, that the quotient obtained by dividing the atomic heat of a compound by the number of elementary atoms in one molecule, is approximately equal to 6·4; equal, that is, to the atomic heat of an element according to Dulong and Petit's law. Thus the atomic heat of the chlorides RCl and RCl has been found to be 12·8 on the average, and of the chlorides $RCl_2 = 18{\cdot}5$. Now $\frac{12{\cdot}8}{2} = 6{\cdot}4$, and $\frac{18{\cdot}5}{3} = 6{\cdot}2$. The same regularity is met with in metallic bromides, iodides, and arsenides; and according to the author's determinations, it is even found in the case of compounds which contain as many as seven, and even of nine elementary atoms. The atomic heat of SnK_2Cl_4 is 43·4, and that of PtK_2Cl_6 is 55·2; now $\frac{43{\cdot}4}{7} = 6{\cdot}2$, and $\frac{55{\cdot}2}{9} = 6{\cdot}1$. But the author shows at the same time that this regularity is far from being general. For the oxides of the metals the quotient is less than six; and is smaller the greater the number of atoms of oxygen in the oxide. (From the average determinations of the atomic heats it is, for the metallic oxides $R\Theta_1 = \frac{11{\cdot}1}{2} = 5{\cdot}6$; for the oxides $R_2\Theta_3$ and $R_2\Theta_3$ $\frac{27{\cdot}2}{5} = 5{\cdot}4$; for the oxides $R\Theta_2 = \frac{13{\cdot}7}{3} = 4{\cdot}6$.) The quotient is still smaller for compounds which contain boron as well as oxygen (for instance, it is $\frac{16{\cdot}8}{4} = 4{\cdot}2$ for the borates, $RB\Theta_3$; it is $\frac{16{\cdot}6}{5} = 3{\cdot}3$ for boracic acid, $B_2\Theta_3$), or which contain silicium (for silicic acid, $Si\Theta_2$, it is $\frac{11{\cdot}3}{3} = 3{\cdot}8$), or hydrogen (for ice, $H_2\Theta$, it is $\frac{8{\cdot}6}{3} = 2{\cdot}9$); or, finally, which contain carbon and hydrogen as well as oxygen (for succinic acid, $C_4H_6\Theta_4$, for instance, it is $\frac{36{\cdot}9}{14} = 2{\cdot}4$). It may be stated in a few words in what cases this quotient approximates to the atomic heat of most of the elements, and in what cases it is less. It is near 6·4 in the case of those compounds which only contain elements whose atomic heats, in accordance with Dulong and Petit's law, are themselves approximately = 6·4. It is less in those compounds containing elements which, as exceptions to Dulong and Petit's law, have a considerably smaller atomic heat than 6·4; and which are found to be exceptions, either directly, by determinations of their specific heat in the solid state, or indirectly, by the method to be subsequently described.

After Dulong and Petit had propounded their law, Neumann showed that a similar regularity existed in the case of compounds, that is, that the atomic heats of analogous compounds are approximately equal. Regnault, as is known, has confirmed Dulong and Petit's, as well as Neumann's law, to a considerably greater extent, and for a larger number of compounds, than had been previously done. And Regnault's researches have more especially shown that the elementary atoms, now regarded as monequivalent, are, as regards the atomic heat of their compounds, comparable with the elementary atoms which are to be considered as polyequivalent. Thus, as regards atomic heat, arsenious acid, $As_2\Theta_3$, and sesquioxide of iron, $Fe_2\Theta_3$, or chloride of silver and subchloride of copper, $CuCl$, may be classed together. Of the applicability of Neumann's law, as hitherto investigated and found in the case of chemically analogous compounds, the author's experimental determinations have furnished a number of new examples. But more interest is presented by his results in reference to the applicability of this law to compounds, to which it had not hitherto been supposed to apply.

In comparing compounds as regards their atomic heat, their chemical character has been taken into account, as represented by the formulæ hitherto adopted. Sulphates and chromates, for instance, were looked upon as comparable, but they would not have been classed with perchlorates, or with permanganates. According to more recent assumptions for the atomic weights of the elements, the following salts have analogous formulæ, and the adjoined atomic heats have been determined:—

Chromate of lead . . .	$PbCr\Theta_4$	29·0
Sulphate of lead	$PbS\Theta_4$	25·8
Permanganate of potass . .	$KMn\Theta_4$	28·3
Perchlorate of potass . . .	$KCl\Theta_4$	26·3

The atomic heats of carbonates, $RC\Theta_3$, of silicates, $RSi\Theta_3$, of metaphosphates, $RP\Theta_3$, of nitrates, $RN\Theta_3$, are also very near.

But not even a common chemical behaviour, such as the bodies in this group possess, that is a common haloid character, is necessary in order that compounds of analogous atomic composition shall show the same atomic heat. No one would think of considering magnetic oxide of iron as analogous to chromate of potass, and yet both have the same atomic structure, and determinations of their specific heat have given approximately the same atomic heat for both.

Magnetic oxide of iron . .	$Fe_3\Theta_4$	37·7
Chromate of potass . . .	$K_2Cr\Theta$	36·4

And it is not less surprising that arseniate of potass, $KAs\Theta_3$, and chlorate of potass have the same atomic heat as sesquioxide of iron, $Fe_2\Theta_3$, or arsenious acid, $As_2\Theta_3$; with very different characters these compounds have approximately equal atomic heat.

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† In accordance with recent assumptions for the atomic weights, H = 1; Cl = 35·5; Θ = 16; S = 32; B = 10·9; C = 12; Si = 28. R stands for a monoequivalent atom, *e.g.*, As = 75; Na = 23; K = 39·1; Ag = 100; R signifies a polyequivalent atom, *e.g.*, Ca = 40; Pb = 207; Fe = 56; Cu = 63·4; Cr = 52·2; Pt = 184, &c.

But comparability of chemical compounds, as regards the atomic heat, is not limited to the cases in which, as far as can be judged, the individual atoms have analogous construction. We do not regard the atom of binoxide of tin or of titanic acid as analogous in construction to the atom of tungstate of lime or of chromate of lead; nor to nitrate of baryta, or metaphosphate of lime. But if the formulæ of these binoxides are doubled or tripled, they may be compared with those salts, and their atomic heats are then approximately equal, as is the case for compounds of analogous chemical character. The atomic heats are for—

Binoxide of tin . .	$2Sn\Theta_2 = Sn_2\Theta_4$	27·6
Titanic acid . . .	$2Ti\Theta_2 = Ti_2\Theta_4$	27·3
Tungstate of lime	$CaW\Theta_4$	27·9
Chromate of lead	$PbCr\Theta_4$	29·0
Permanganate of potass. . .	$KnM\Theta_4$	28·3
Perchlorate of potass . . .	$KCl\Theta_4$	26·3
Binoxide of tin . .	$3Sn\Theta_2 = Sn_3\Theta_6$	41·4
Titanic acid . . .	$3Ti\Theta_2 = Ti_3\Theta_6$	41·0
Nitrate of baryta	$BaN_2\Theta_6$	38·9
Metaphosphate of lime . . .	$CaP_2\Theta_6$	39·4

These results seem to give to Neumann's law a validity far beyond the limits to which it had hitherto been considered to apply. But, on the other hand, the author's comparisons go to show that neither Neumann's nor Dulong and Petit's law is universally valid.

Neumann's law is only approximate, as is well known. For such analogous compounds, as from what we know at present, are quite comparable, and in accordance with this law ought to have equal atomic heats. Regnault found the atomic heats differing from each other by one-tenth to one-ninth. In a few such cases there are even greater differences in the atomic heats, for which an adequate explanation is still wanting.

But there are other differences in the atomic heats of some compounds which might have been expected to have equality of atomic heat in accordance with Neumann's law, differences which occur with regularity, and for which an explanation is possible. Certain elements impress upon all their compounds the common character, that their atomic heats are smaller than those of analogous compounds of other elements. This is the case, for instance, with the compounds of boron; the atomic heat of boracic acid is much less than that of the metallic oxides, $R_2\Theta_3$ and $R_2\Theta_3$; the atomic heat of the borates, $RB\Theta_2$, is much less than that of the oxides, $R_2\Theta_2 = (2R\Theta)$, and the atomic heat of borate of lead, $PbB_2\Theta_4$, is far less than that of magnetic oxide of iron, $Fe_3\Theta_4$. The same is the case with compounds of carbon, if the alkaline carbonates $R_2C\Theta_3$, are compared with the metallic oxides, $R_3\Theta_3 = (3R\Theta)$, or the carbonates, $RC\Theta$, with the metallic oxides, $R_2\Theta_3$ and $R_2\Theta_3$. It is seen that the compounds of those elements which, in the free state, have themselves a smaller atomic heat than most other elements, are characterised by a smaller atomic heat.

(To be continued.)

Permanent Stratification produced by the Spark of Induction; new arrangements of the Interrupters, by M. l'Abbé LABORDE.

SEVERAL physicists have investigated the stratified light of the electric spark, and have assigned various causes for this curious phenomenon. The various researches on this subject have ended in establishing beyond doubt one fact only, that the alternately light and dark bands are formed in a ponderable matter. I have succeeded in producing, on a semi-conducting surface, an analogous stratification; transverse rays whose durable impression no doubt will facilitate the study of this phenomenon.

To prepare this semi-conducting layer, pour on a glass plate some iodised collodion, and then let it undergo all the operations necessary to produce a photographic plate. A suitable surface cannot invariably be obtained. The layer, in fact, does not conduct the electricity when the reduction of the silver is not sufficiently advanced, and the spark passes over without attacking. This is generally the case with solarised surfaces with a reddish tint. If, on the contrary, the silver is completely reduced, and presents a metallic and mirror-like layer, it conducts too well, and the spark traverses without modifying it. Between these two extremes surfaces are obtainable more or less conducting, on which the spark produces more or less compact strata, of very varied appearance.

They are not regular, like the bands of light formed in a perfectly homogeneous medium, but, whatever their form, they always appear transversely to the spark; in all my experiments I have not found a single exception.

These designs, traced by electricity on an opaque surface, are transparent, which allows of their reproduction directly on a paper prepared with chloride of silver. Manifold details are lost in this operation which the microscope reveals on the negative plate.

In practising photography, so many negative plates are rendered useless that the simplest way is to use them for the trials, instead of preparing others expressly; and it is very uncommon to be unable to find a suitable surface, especially among negative plates on which the image has been developed by pyrogallic acid; the varnish which covers them being no disadvantage. The two ends of the induction wire are placed a little distance apart on the surface, and, according as it is more or less conducting, the spark produces stratification on it in a few seconds or a few minutes.

The strata are inflected towards the poles like stratified light in vacuo, with a characteristic difference by which the positive and negative poles can always be distinguished. Towards their extremities there takes place always a peculiar arborisation, and the bodies of the strata, examined under the microscope on the negative plate, seem formed of finer and more compact arborisations. By studying, for the purpose of finding them, the bands of light produced in a vacuum, some similar arrangement will perhaps be found; in fact, a sort of vibration is observable, which may result from each spark without effecting any change in the general form, producing a different arborisation.

The stratifications always commence at the negative pole and extend progressively to the positive pole. The following experiment makes apparent this property of the negative pole:—The two ends of the induction wire being placed on a semi-conducting surface, withdraw from time to time the negative extremity. The spark, opening a way for itself, may thus extend to sufficiently considerable distances, and each point of stoppage of the negative wire is marked by an arborescent stratum, which continues to develope itself under the induced current. A different effect is produced by now and then withdrawing the positive wire, the negative wire remaining stationary.

Certain surfaces are very readily attacked by the spark. The stratifications are then more compact, and are produced from one pole to the other immediately. If the current is continued they are developed and encroach one upon the other; but although in the end confused, an experienced eye can still distinguish that they have existed.

When the ends of the induction wire do not touch the surface, but project the spark to a distance, the design is not so easily produced, and presents a peculiar appearance. The stratifications are less marked and less arborescent. This is perhaps occasioned by the induction current on closing the circuit being suppressed, so that only the induction current formed when the circuit is opened exerts its action.

The spark often deviates from the straight line, and when persisting to the right or left adds lateral stratifications to the principal figure.

I have tried the spark of the ordinary electric machine, and found that it also produced transverse rays; but it penetrates with more difficulty than the induction spark, and remains long on the surface. An easily attacked surface should be selected, and the action should be prolonged so as to produce a sufficiently fine result.

I used a mercury interrupter, which presents a special advantage; it is now known that the soft iron of the electro-magnet does not immediately acquire its full power, either because it opposes a certain resistance to magnetism, or because, in the first instance, the effect of the principal current is opposed by the counter current which it engenders. In automatic interrupters the contact is hardly established when it is broken by the attraction of the soft iron before it could attain the maximum of magnetism. In the interrupter about to be described, the part touching the mercury instead of severing from it by the attraction of the soft iron, sinks, on the contrary, still deeper, and severs from it an instant afterwards. It is composed of a small bar of soft iron, traversed in the centre by a horizontal axis on which it turns, presenting its extremities alternately to the soft iron of the electro-magnet. A small wheel fixed on the axis is furnished with two teeth inclined opposite to each other. These teeth, or small inclined planes, raise by turns the extremity of a lever oscillating on an axis, and plunges the other end in the mercury, upon which alcohol has been poured. The communication is thus properly effected; the excited electro-magnet attracts the superior end of the little bar, and before it has passed the line of force the inclined tooth escapes the lever, which is pushed by a spring away from the mercury. The same effect is produced when the bar presents its other extremity to the electro-magnet, and, if unopposed, assumes a very rapid rotatory movement. The induced sparks do not succeed each other so promptly as with the hammer interrupter; but they are more regular, brighter, and longer.

I have modified the hammer interrupter in a way which renders it more efficacious. Its iron rod is surrounded with three layers of thick wire covered with silk; one of the ends is soldered to the head of the hammer, and the other is fastened by a moveable communication to the inducting wire towards the hinge at the handle of the hammer. The current then passes, not by the rod, but by the wire surrounding it, and is so directed that the hammer receives a contrary magnetism to that of the soft iron of the apparatus. The attraction becomes stronger, and in spite of the increased weight of the hammer more tension can be given to the spring pressing against the magnet. The result is more intimate contact and more complete action with each movement.—*Comptes Rendus*, lviii. 661.

PHOTOGRAPHY.

On the Application of Potassio-Ammonium Chromate to Photography, by M. E. KOPP.

POTASSIO-AMMONIUM chromate, whether pure or with the addition of an ammonium salt, the acid of which may vary as the operator wishes, more or less, to modify the reaction, is an excellent photographic agent, since the undecomposed salt will not attack cellulose. It is especially useful for obtaining positive images from negatives prepared by the ordinary processes.

The paper may be impregnated with a concentrated solution of the salt, and left to dry in the dark at the ordinary temperature without undergoing any alteration.

The paper remains yellow, and it is only after a long time, and very gradually, that it assumes an orange-yellow tint. It remains active for a considerable time.

But on exposure to daylight, and especially to the direct rays of the sun, the paper thus prepared soon acquires a brown colour, becoming deeper and more intense.

By covering the prepared paper with an engraving and then with a plate of glass, so as to press the engraving on to the paper, after a few minutes' exposure to the solar light, a very distinct negative image will appear. If the engraving is previously oiled, or an ordinary collodion negative is used, two or three minutes' exposure to the solar rays will produce a very defined effect.

By washing the paper in pure water or acidulated with one or two drops of acid, the unaltered chromate is dissolved; the image is then fixed, and may, without fear, be dried in the light.

The washing must not, however, be prolonged more than is absolutely necessary, if it is desired to preserve the characteristic yellowish-brown tint, nor must the picture undergo further treatment.

There seems no doubt that potassio or sodio-ammonium chromate may advantageously replace bichromate of potash in all photographic processes in which the latter salt is used, as, for instance, in gelatine, carbon, &c., photographs.

The reaction producing the image, and the behaviour of the latter, under considerably varied and interesting circumstances, may be easily explained.

Under the influence of light the potassio-ammonium chromate loses its ammonia, becomes acid, and the chromic acid then reacting on the cellulose, partly oxidises it, and is, at the same time, reduced to brown chromic peroxide—CrO_2.

This peroxide $CrO_2 = Cr_3O_6 = CrO_3,Cr_2O_3$ may also be considered as a chromate of chromium—that is to say, as resulting from the combination of chromic acid with green oxide of chromium, and, in fact, even with feeble affinities it is separated readily into chromic acid and oxide of chromium.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 2, 1864.

Professor A. W. WILLIAMSON, *Ph.D., F.R.S., President, in the Chair.*

IN continuation of our report of Professor Stokes's discourse "*On the Detection and Discrimination of Organic Bodies by Means of their Optical Properties*," we proceed with the lecturer's description of the optical characters of chlorophyll, the green colouring matter existing in plants. Although little is known as yet regarding the nature and composition of chlorophyll, the author considered there were sufficient grounds for believing that this green pigment was really made up of two separate principles, or kinds of colouring matter, which exhibited distinct optical properties; thus, one of the components showed in the spectrum a group of bands between F and G, whilst the optical character of the second body was much simpler. If green leaves were macerated for a short time with dilute alcohol the coloured infusion gave one band nearly coinciding with the line F, and another between F and G, but when bisulphide of carbon was used as the solvent the two bands were shifted nearer the red end of the spectrum to the extent of one band interval. If a mixed solvent were employed the group occupied an intermediate position; and the addition of an acid to the sulphide of carbon solution moved the bands back again to the same position as they were found to occupy in the alcoholic extract. The author then described the character of fluorescence as exhibited by quinine, "leaf green," fluor spar, and a variety of vegetable organic substances. When the bright rays of the sun or of the electric spark were allowed to fall upon the surface of an aqueous solution of a quinine salt, it was well known that a brilliant azure-blue colour was developed, which made its appearance not only under the blue and violet portions of the spectrum, but extended from a point midway between the fixed lines G and H for a considerable distance into the chemically active, but otherwise invisible, part of the spectrum. The production of these blue rays was quite independent of a decomposition of light in the incident beam, and the author had already shown that their appearance was due to a change of refrangibility of the light always on the side of diminution; whilst with leaf-green infusion, which showed a red fluorescence, the alteration in the degree of refrangibility, still in the same direction, was made apparent in a different manner. It was possible to observe simultaneously these optical effects, inasmuch as they occurred at different parts of the spectrum, if the precaution of taking a sufficiently diluted solution of the mixed substances were adhered to; that is to say, the absorption of the fluorescent light by too highly coloured a solution must of course in such a case be guarded against. By a series of coloured diagrams the author showed conclusively the manner in which he had proved fluorescence to be but the effect of a diminution in the degree of refrangibility, the blue rays of the solar spectrum were collected by a lens and passed throught a sufficient layer of the sensitive medium, the transmitted beam was then analysed by a prism and shown to consist of light of different degrees of refrangibility, but always inferior to that of the producing ray. The lecturer then proceeded to show some very beautiful experiments with a number of fluorescent substances, which were successively illuminated by the spark discharge of a Ruhmkorf coil, having a Leyden jar in circuit, and the power of window glass in cutting off the active rays was exhibited in comparison with a plate of quartz ·4 inch in thickness. The latter did not in any appreciable degree obstruct the passage of the fluorescent rays, whilst the window-glass, no more than ·1 inch thick, cut off nearly all. Among the substances thus experimented with were aesculin and fraxin, (the alkaloids contained in the bark of the horse-chestnut), purpurin from madder, which showed a yellow fluorescence, and solutions of terephthalic acid kindly furnished by Drs. De la Rue and H. Muller. The etherial solution of this last-named substance showed a bluish fluorescence, whilst the aqueous solution appeared green. By the optical examination of the permanganate of potash the lecturer discovered that the crystals by reflected light showed bands of maxima brilliancy exactly corresponding to the dark bands absorbed by the solution; it thus appeared that the crystallised salt partook of the optical characters of a metal and of a vitreous substance alternately. Similar quasi-metallic reflections were seen also in the platinocyanide of magnesium and in some of the crystallised aniline colours. In conclusion the author compared these results with the well-known observation that gold leaf showed a greenish hue by transmitted light, whilst it appeared of a rich yellow by reflected light; many other instances of notable variations in colour presented by chemical products would suggest themselves to his hearers.

The PRESIDENT, in proposing a vote of thanks to Professor Stokes (which was warmly responded to), commented upon the importance to be attached to the lecturer's remarks, both as regards methods and results. Much had already been accomplished towards extending the means of physical observation, and no research would be considered complete unless it comprehended a statement of the optical characters of the substances in question. The speaker concluded by inquiring of Professor Stokes whether he was acquainted with any instance of a substance undergoing decomposition during the process of solution?

Dr. ODLING asked whether any good explanation, founded on optical tests, could be assigned in the case of the well-known fact that iodine when dissolved in alcohol or ether gave a brown solution, whilst with other solvents, particularly chloroform and bisulphide of carbon, the colour of the solution was violet? Whether there appeared to be any connexion between the mode of absorption characterised by iodine vapour and that of the bisulphide of carbon solution?

Professor STOKES, in reply to the President, mentioned the fact of the green chloride of copper becoming blue on dilution; but, in answer to Dr. Odling's inquiry, said he was not prepared to give any theoretical explanation of the facts alluded to.

The PRESIDENT requested, on the part of the Council, that Professor Stokes would be so good as to prepare an abstract of his communication for the purpose of being published in the Society's Journal.

Dr. GLADSTONE suggested that if the lecturer would kindly enlarge upon the subject he had in so interesting a manner brought before them, he felt sure the Society would consider themselves even further indebted to Professor Stokes.

The meeting was then adjourned until the 16th inst.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. PERCY, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

LECTURE X.—*Saturday, January 23.*

(Continued from page 248.)

THE first carbonaceous deposit we shall consider is peat or turf. This substance has played a very important part in this country as a fuel, and is still extensively used, but it is much more valuable in other countries which do not possess those magnificent deposits of coal occurring in this country, and which are being so terribly misused, owing to a want of economy in the burning of the fuel. Of that we will speak hereafter.

Peat is a product of the natural decay of various plants under special conditions of heat and moisture, and those special conditions occur in humid and temperate climates. Still we find peat in tropical regions, as I shall show you by-and-by. Immense accumulations of peat, as every one knows, exist in our peat-bogs in Ireland, and also in various parts of this country. It is abundant also in the central parts of France and other parts of Europe. It is found also in mountain declivities, where it seldom exceeds four feet in thickness. The peat of Europe is generally derived from mosses of the genus *sphagnum*—a very beautiful genus it is. Here we have a specimen of peat from the museum above; it was brought by Dr. Falconer from the bottom of a lake in Thibet. The remains of diatomaceæ have been found in it by Mr. Etheridge. This, again, is a variety of peat from the Neilgherry Hills in India.

It is certain that many peat-bogs occupy the sites of former forests, and sometimes we find in those bogs trees of large dimensions. I have here the names of some of the plants which have been found in Calcutta peat. Peat occurs there dug out a few feet below the surface of the soil. It contains remains of phænogamous plants.

As the peat is composed of the tangled remains of the plants from which it has been derived, a peat bog presents us with peat in various stages of decomposition. The decomposition is advanced, as we should naturally expect it would be, in proportion to the depth of the peat bog; so that when we take peat out from the bottom of a peat bog, it may present to the eye scarcely any visible trace of organic structure—plant structure—whereas we shall see the plant from which it has been formed growing on the surface luxuriantly. Between those two conditions—the living plant and the decomposed mass—we find every gradation.

The composition of peat is interesting in relation to that of wood. I will give it to you directly in a connected form.

In the ashes of peat, we find not only those inorganic elements which exist in the plants forming the peat, but clayey matter—silicate of alumina and so forth—which have been derived from extraneous sources. Bogs are subject, for example, to inundation, and sandy or clayey matter may be washed in, and so become intimately mixed with the peat. This has occurred also in the formation of many coal seams. I could take you down a pit where you may see the coal interspersed with sandstone, which has no doubt been produced in the way I spoke of—from the washing in by floods, or otherwise, of extraneous matter not forming part of the plants originally. Copper has been known to occur, and pretty abundantly, in the peat of North Wales, and we find also iron pyrites even to a large extent—to such an extent that it has been profitably used as a source of sulphate of iron, which is produced by the weathering action of the sulphide contained in the peat.

I need not trouble you with a complete analysis of peat. It contains a variety of very imperfectly known organic constituents—stuff called humic acid, and so forth.

The next deposit of carbonaceous matter of interest to us is coal. We all fancy that we know perfectly well what coal is, and that there would be no difficulty in constructing a suitable definition of coal; and yet it is probably one of the greatest difficulties one could have to solve to give such a definition of coal as would be unmistakably and perfectly applicable to all the substances we term "coal." The question gave rise to a very extensive and costly trial some time ago in Edinburgh, the results of which have been recorded in a quarto volume which we have in the library. It is quite amazing to see the varied opinions expressed on the subject. Numerous witnesses were examined—some chemists, some botanists, some mineralogists, some geologists, and some gas engineers, and the evidence was extremely conflicting, half a dozen witnesses saying one thing, and half a dozen another; so that the judge and jury were all puzzled, and the scientific evidence was altogether ignored. The judge took a common-sense view of this subject, but they could not succeed in producing a satisfactory definition of coal. Perhaps a near approach to a definition of coal would be the following:—We may define it to be "a solid mineral substance, more or less easily combustible, and varying in colour from dark brown to black; opaque, except in very thin slices; brittle; not fusible without decomposition; not sensibly soluble in ether or turpentine; and not containing sufficient earthy matter to prevent its being applied as a source of heat." You will see one difficulty about this in a moment. Coal in coal beds occurs along with shaley matter. Coal generally contains, as we shall see presently, a clay with which it is associated. We may get a coal which contains a considerable amount of shaley matter, and a shale which contains a considerable amount of carbonaceous matter. Now, I should like any one to tell me where the coal ceases and the shale begins. We may have a shale containing 1 per cent. of carbonaceous matter, and we may have others containing 2, 3, 4, 5, 6, or 10 per cent., and so on, till at length we get what people would call coal; but it is impossible, I think, to define exactly where the one begins and the other ends. There is no doubt as to the nature of peat, because we see the transformation from living vegetable matter to peat. Coal is also as certainly derived from vegetable matter. We find the remains of plants associated with the coal, above the coal, and below the coal. There is no question whatever about that fact.

Let me now direct your attention to the varieties of coal which occur. There are some points which I think you will admit to be of geological interest in connection with this part of our subject. We begin with woody tissue, pass on to peat, and then arrive at coal. We have a class of coal approximating to peat in composition, intermediate between peat on the one hand, and our true so-called bituminous coals on the other. To this intermediate description of coal the name of lignite has been given, or brown coal. We have valuable deposits of this lignite occurring at Bovey Tracey, in Devonshire. Lignite is found also in various other parts of the world. I have collected analyses of different sorts of lignite, and presented them in the form of a table. There is one point about them which is characteristic: they all contain, so far as my experience goes—I speak here of course with a certain degree of reservation—a considerable amount of hygroscopic water—much more than any true coal I ever saw—sometimes 15, 18, or 20 per cent.; and in so far these varieties of lignite resemble wood in a remarkable degree. All our common wood, dry as it may appear, —even this deal table which I now touch—contains a large amount of water, which may be displaced by exposing the wood to a temperature below that required to effect its decomposition. The volatilisation of water from wood, and its reabsorption from the air under different conditions, occasions that crackling which we hear in our furniture from time to time. The water of the lignite may be expelled by exposing the substance to a certain amount of heat, but on cooling and re-exposure to the air, it reabsorbs the water which it has lost.

We have bituminous coal, occurring in England, Staffordshire for example, which comes next in order after lignite. Then we have a steam coal from the Tyne, and at last the so-called anthracitic coal from Wales. I have drawn up a table so as to give you at a glance the comparative composition of all the typical varieties of coal. The figures are deduced from a very large number of analyses. I will take the carbon as represented by 100 in every case, so as to enable you to compare the successive changes in composition which take place from wood to coal. I will ignore the nitrogen as not a material item in our consideration.

	Carbon.	Hydrogen.	Oxygen.
Woody tissue	100	12·18	83·07
Peat.	100	9·85	55·67
Lignite	100	8·3	42·42
South Staffordshire coal . .	100	6·12	21·23
Steam coal from the Tyne. .	100	5·91	18·32
Semi-anthracitic coal from South Wales	100	4·75	5·28
Anthracite from Pennsylvania .	100	2·84	1·74

That table is drawn up with a great deal of care from a vast number of analyses, and it will give you at a glance the comparative composition of all these varieties of carbonaceous deposits from wood down to anthracite, which is the farthest removed from wood in composition. You see how beautifully gradual the change is all the way down. Mark the great diminution of oxygen in peat compared with the quantity contained in the woody tissue. You will, of course, understand with regard to lignite that the various lignites differ considerably in composition, but the analysis I have just presented to your notice is an average taken from the analysis of several varieties from different parts of the world. You see how the quantity of carbon creeps up as we get away from wood. The South Staffordshire coal, of which I have given you the composition, is of the same sort as occurs in some other parts of England. It is a free-burning coal, that is to say, it burns without caking together like our Newcastle coal, and produces a long flame. It is extensively used in Staffordshire, not only for household purposes, but also in metallurgical operations. There is a great diminution in the oxygen compared with lignite, and yet this variety of coal contains more oxygen than any other varieties of coal we have. The amount of oxygen is quite characteristic. I need hardly say that the less oxygen we have under ordinary conditions the better the coal, because the oxygen is almost all so much dead loss. The oxygen that we find in coal may be regarded as existing in combination with hydrogen in the state of water, and does not cause heat; but on the contrary, it has to be evaporated, and must cause a loss of heat. We have an abundance of anthracite from South Wales of nearly the same composition as the anthracite from Pennsylvania, of which I have given you the analysis.

We have all seen, in walking by a stagnant pool from time to time, little bubbles of gas starting up on the surface of the water. If we collected that gas and burned it, we should find that it is light carburetted hydrogen or marsh gas, containing more or less carbonic acid. In our coal mines we find that marsh gas exists in the coal much in the same way as condensed air exists in spongy charcoal. By abstracting from woody tissue certain proportions of hydrogen, carbon, and oxygen in the two states of carbonic acid and carburetted hydrogen, we can produce every variety of carbonaceous deposit, the composition of which I have represented to you in the table I have given.

ACADEMY OF SCIENCES.

June 6.

M. Payen has examined an old wooden wheel which General Morin found in an abandoned copper mine in St. Domingo. It was in an excellent state of preservation, though no one knows how old. M. Payen found the wood to contain a large amount of iron and some copper, to the presence of which its preservation must be attributed. This is a satisfactory confirmation of the value of a modern application—not very modern, however; for it seems that Pallas, in 1719, recommended wood to be saturated with green vitriol. It should be known that moisture is essential to the preservation. Wood, treated in this way and then exposed sometimes to a dry and sometimes to a moist atmosphere, soon decays.

M. Kulhmann contributed a memoir "*On the Crystallogenic Force*," which, he seems to say, is a sort of molecular attraction governed by some general law, and which plays an important part in a great number of natural phenomena —a conclusion which we do not suppose anybody will dispute. The particular illustrations the author mentions do not seem to us important; but we shall quote the account of fluoride of thallium given in a note to the memoir.

Mr. Oppenheim contributed a paper "*On the Action of Bromine and Iodine on Allylene.*" The author has formed, and here describes, the bibromide, tetrabromide, and biniodide of allylene.

M. L. Grandeau contributed an important note "*On the Application of Dialysis to the Separation of the Alkaloids; and a New Test for Digitaline.*" Digitaline, it would seem, passes readily into the diffusate, which we should not have expected. A dilute solution evaporated to dryness and the residue treated with sulphuric acid gives a rose coloured spot. When exposed to the vapour of bromine this spot turns violet. In this way 0·0005 of a gramme of digitaline may be detected. The author adds a long list of alkaloids which do not give this reaction, and as the paper contains some other things of interest, we shall translate it at length.

A note by M. Dufour "*On the Ebullition of Water and the Bursting of Steam-Boilers*" contains a suggestion. Water when deprived of air, as Mr. Grove has shown, does not boil steadily, and hence the author thinks boiler explosions result. Let it be kept well supplied with air, then, by carrying into the boiler two platinum wires connected with a voltaic pile.

Some time ago M. L. Cailletet communicated a note "*On the Permeability of Wrought Iron by Hydrogen at High Temperatures.*" The gas passed through plates several millimetres thick, at a red heat; the author now shows that when cold, or at a temperature of 210° C., hydrogen will not traverse a plate of only $\frac{1}{3}$th millimetre thickness.

In a note by M. Reboul entitled "*On some non-Saturated Bodies belonging to the Group of Mixed Ethers,*" the author describes a compound resulting from the action of alcoholic potash on a bromated compound of amylene.

NOTICES OF BOOKS.

Journal für Praktische Chemie. No. 8. 1864.

The articles in this number are of no special interest, and we give only the titles. They consist of papers on Aifvedsonite, by Kobell; an account of some Analyses of various Gaseous and Fluid Volcanic Products; On Silico-fluoride of Lithium, by Stolba; Researches on the Beet-plant, by Hoffmann, of Prague. Of more interest to some chemists will be a series of short notices of some Compounds and Substitution Products of Aceton, by Dr. E. Mulder; and a paper by Rochleder on the Constitution of Organic Compounds, and the Origin of Homologous Bodies. A Method for the Estimation of Carbonic Acid in Mineral Waters, by L. Meyer, does not seem to possess much advantage over the methods in common use, and, moreover, is very troublesome.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

299. James Young, Bucklersbury, London, "Improvements in the preservation of vegetable and animal matters."—Petition recorded February 4, 1864.

1038. John Frederick Brinjes, Fieldgate Street, Whitechapel, Middlesex, "Improvements in apparatus for the reburning of animal charcoal."—Petition recorded April 23, 1864.

1179. Alfred Silvester, New Dorset Place, Clapham Road, Surrey, "An improved apparatus for obtaining certain theatrical effects."—Petition recorded May 10, 1864.

1278. William Edward Newton, Chancery Lane, Middlesex, "Improvements in the construction of fuses for projectiles."—A communication from Arthur Anthoni Vorus, Rue St. Sebastien, Paris, France.—Petition recorded May 20, 1864.

1291. Matthew Piers Watt Boulton, Tew Park, Oxfordshire, "Improvements in engines worked by means of heated air or gases or steam, part of which invention is also applicable to compressing air and aeriform fluids."—Petition recorded May 24, 1864.

1296. Benjamin Jones, Warrington, Lancashire, "Improvements in the mode or method of obtaining sulphur from alkali or blue waste."

1300. George Shaw, Birmingham, Warwickshire, "Improvements in apparatus for heating the steam boilers of stationary, locomotive, and marine engines, for heating stoves, and for heating purposes generally."—A communication from August Conrad Dewies, Liège, Belgium.

1303. George Schaub, New Hanley Road West, Upper Holloway, Middlesex, "An improved mode of transmitting currents of electricity for telegraphic purposes."—Petitions recorded May 25, 1864.

1319. Arthur Wall, Clapton, Middlesex, "Improvements in purifying oils, in converting fatty, vegetable, mineral, or fishy substances into oils, and in the machinery or apparatus used therein."—Petition recorded May 27, 1864.

1325. John William Lees, Waterhead Mill, near Oldham, Lancashire, "Certain improvements in the method of cleaning and preventing the formation of deposits upon the heating apparatus employed in boilers generating steam."

1327. John Thomas, Battersea, Surrey, "An improved paint."—Petitions recorded May 28, 1864.

1349. James Young, Bucklersbury, London, "Improvements in the treatment or distillation of bituminous substances."—Petitions recorded May 31, 1864.

1355. Richard Edward Donovan and Robert Bowles, Dublin, "Improvements in the means for the prevention of fraud by altering cheques, drafts, bills, I O U's, and documents of any description relating to the payment and receipt of money."—Petition recorded June 1, 1864.

Notices to Proceed.

202. John Piddington, Gracechurch Street, London, "Improvements in the manufacture of paper from straw and other analogous vegetable fibrous substances."—A communication from Augustus Henry Tait, William Henry Holbrook, and Asahel Knowlton Eaton, U.S. America.—Petition recorded January 23, 1864.

249. Bryan I'Anson, Bromwich, Birmingham, Warwickshire, "Improvements in the construction of casks or vessels for the storing of wines, spirits, and other liquids or fluids."—Petition recorded January 29, 1864.

260. Edward Thomas Hughes, Chancery Lane, London, "Improvements in submarine batteries."—A communication from Henry Doty and William Porter Downer, Rue Gaillon, Paris, France.

281. George Hammond, Manchester, and James William Kemp, Salford, Lancashire, "Improvements in the manufacture of illuminating gas, and in apparatus to be employed therein."—Petition recorded February 2, 1864.

320. Marie Celeste de Casteras Sinibaldi, South Street, Greenwich, Kent, "Improvements in the manufacture of plates, tubes, cylinders, and other articles, and for covering or coating the same with copper, brass, or other metals."—Petition recorded February 6, 1864.

351. Marie Celeste de Casteras Sinibaldi, South Street, Greenwich, Kent, "Improvements in coating with copper, brass, or other metals the surfaces of ships and other structures of iron or steel."—Petition recorded February 10, 1864.

588. Felix Spiers and Christopher Pond, Prince's Street, Cavendish Square, Middlesex, "Improvements in closing or stoppering bottles."—A communication from Barlow William Mallam, Melbourne, Victoria.—Petition recorded March 9, 1864.

834. Leonard Cooke, Horwich, Lancashire, "Improvements in the manufacture of paper."—Petition recorded April 4, 1864.

1151. Andrew Barclay, Kilmarnock, Ayrshire, N. B., "Improvements in certain apparatus for injecting and ejecting fluids."—Petition recorded May 6, 1864.

1172. Henry Aitken, Falkirk, Stirlingshire, N. B., "Improvements in the system or mode of calcining and extracting the oils and gases from ironstone and other materials, and in the apparatus or means employed therefor."—Petition recorded May 9, 1864.

1243. Richard Archibald Brooman, "Improvements in dyeing wool and other filamentous and textile materials, and in machinery employed therein."—A communication from Jean Henri Chaudet, Rouen, France.—Petition recorded May 17, 1864.

MISCELLANEOUS.

Antiasthmatic Paper.—

Leaves of belladonna	5
,, of datura stramonium	5
,, of digitalis	5
,, of sage	5
Tincture of benzoin	40
Nitrate of potash	75
Water	1000

Make a decoction of the plants, dissolve the nitrate of potash in the liquid, add the tincture of benzoin, and plunge into the liquid, leaf by leaf, a quire of red blotting-paper. After twenty-four hours withdraw the paper, let it dry, and divide it into squares ten centimetres long by seven broad, and enclose them in boxes.—*Journal de Pharmacie et de Chimie.*

Restoration of Pictures.—Professor Pettenkofer, of Munich, who, it may be remembered, has invented a method for restoring pictures, has just patented his invention in this country. The nature of the process, which has been for some time an object of much speculation, is extremely simple, and is mechanical, not chemical. The change which takes place in pictures, he says, is "the discontinuance of molecular cohesion," which "process begins on the surface with microscopical fissures in the varnish, and penetrates by-and-by through the different coats of colours to the very foundation. The surface and body of such a picture become in the course of time intimately mixed with air, and reflect light like powdered glass, or loses its transparency like oil intimately mixed with water or air." The process consists in causing these molecules to re-unite, which he does as follows:—The picture is exposed in a flat case, lined with metal, to an atmosphere saturated with vapour of alcohol at the ordinary temperature, which vapour is absorbed by the resinous particles of the picture to the point of saturation. The different separated molecules thus "re-acquire cohesion with each other, and the optical effect of the original is restored solely by self-action, the picture not getting touched at all." Other substances besides alcohol—such as wood-naphtha, ether, sulphuric and other ethers, turpentine, petroleum, benzine, &c.—may be used. The process seems to have been very successful at Munich, where Professor Pettenkofer restored some almost invisible pictures to very nearly their original freshness. Liebig has reported favourably on the method, and has given it as his opinion that it cannot injure the paintings—which, indeed, is almost a consequence of its extremely simple nature.—*Reader*.

ANSWERS TO CORRESPONDENTS.

W. A. W.—We hope to begin early in the next volume.

A Subscriber.—The patent is not yet published; but you may see it at the Patent Office in Chancery Lane.

Chlor-Kalium.—There is no "ready and simple method." You must estimate the chlorine and the potassium, and sulphuric acid if present, and combine your results in the usual way.

Book Received.—"Companion to the British Pharmacopœia," etc., etc. By P. Squire.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Separation of Cerium from Didymium and Lanthanum, by Wolcott Gibbs, *M.D., Rumford Professor in Harvard University.*

The methods which have recently been proposed for the separation of cerium from lanthanum and didymium are familiar to chemists, and do not require recapitulation in this place. They all depend, like the older methods, upon the oxidation of cerium to a sesquioxide, or to Ce_3O_4, and upon the formation of insoluble basic salts of the sesquioxide. No one of these methods effects a complete or quantitative separation, though all afford means of obtaining salts of cerium in a state of chemical purity. The following observations upon this subject are believed to be new:—

When a salt of cerium, lanthanum, and didymium is boiled with dilute nitric acid, and peroxide of lead added to the solution, the cerium is quickly, and under some circumstances completely oxidised, the solution becoming more or less deeply orange-yellow. This process affords an extremely simple and delicate test for cerium; it succeeds with all the salts which are soluble in nitric acid, though, of course, when the mixed oxalates are tested the oxalic acid is oxidised to carbonic acid before the characteristic cerium yellow appears. For the purpose of testing, it is sufficient to dissolve the salt to be examined in nitric acid, diluted with its own volume of water, to add a small quantity of pure peroxide of lead, and boil for a few minutes, when the smallest trace of cerium can be detected by the yellow colour of the solution. The reaction is here exactly analogous to that of nitric acid and peroxide of lead with solutions of manganese, which last is oxidised, not as Crum supposed, to hypermanganic acid, but, as Rose has shown, to sesquioxide.

When a solution containing a salt of cerium dissolved in strong nitric acid is boiled for a short time with a large excess of peroxide of lead, oxygen gas is copiously evolved, and at the same time the sesquioxide of cerium formed at first is completely reduced to protoxide, the solution becoming perfectly colourless. The remarkable reaction which occurs in this case appears to be connected with the formation of nitrate of lead, since, when the solution of protoxide of cerium contains a large excess of this salt, the cerium is not peroxidised by boiling with nitric acid and the peroxide.

Solutions of cerium salts are also oxidised by boiling with peroxide of lead and dilute sulphuric acid, but the protoxide of cerium, in the nearly insoluble double sulphate of soda and the cerium metals is only partially oxidised by heating with strong sulphuric acid and peroxide of lead, although oxygen is freely evolved.

A solution of hypermanganate of potash has no immediate action upon a solution of protoxide of cerium either in nitric or in sulphuric acid, the violet colour remaining unchanged even in a hot solution. On boiling for some time, however, the colour changes slowly, the solution gradually becomes yellow, and a brown flocculent precipitate is thrown down, which consists of hydrate of sesquioxide of manganese.

According to Stapff, a solution of hypermanganate of potash immediately decolorised by a solution of the sulphate of potassium and protoxide of cerium in chlorhydric acid, but after some time chlorine is evolved, and the sesquioxide of cerium found is reduced to protoxide. It is clear that in this case the oxidising agent is chlorine. The further investigation of this subject was committed to Dr. T. M. Drown, who has obtained the following results:—

When a solution of cerium, didymium, and lanthanum is treated with nitric acid and peroxide of lead in the manner pointed out above, the deep orange-coloured liquid evaporated to dryness, and heated for a short time to a temperature sufficiently high to expel a portion of the acid, it will be found that boiling water acidulated with nitric acid dissolves only the salts of lanthanum and didymium, leaving the whole of the cerium in the form of basic nitrate insoluble in water. The insoluble matter is to be filtered off and thoroughly washed. A current of sulphydric acid gas passed into the filtrate removes the lead, after which the lanthanum and didymium may be precipitated together as oxalates, which, if the process has been carefully performed, are perfectly free from cerium. The mass on the filter is readily dissolved by fuming nitric acid. Sulphydric acid is then to be passed through the solution sufficiently diluted with water until the lead is completely precipitated. The cerium may then be thrown down by oxalic acid ignited and weighed as Ce_3O_4, or as sulphate. In this manner Dr. Drown obtained in four analyses of the same salt—DiO and LaO = 24·84, 25·31, 25·54, 24·65 per cent.

Nitrate of protoxide of cerium obtained by this process gives, when tested by the spectroscope with transmitted light, even in very thick layers, a scarcely perceptible indication of didymium. I may here mention that Gladstone's lines furnish, with proper care, the most delicate test for the presence of didymium which we possess. It is only necessary to transmit the light through very thick layers of liquid, and to empty a condensing lens so as to throw the transmitted light directly upon the slit of the spectroscope.—*American Journal of Science*, vol. xxxvii. p. 352.

Researches on Affinities.—The Formation and Decomposition of Ethers, by MM. Berthelot *and* L. Pean de Saint-Gilles.

We have already given our experiments as to the limits of etherification—that is to say, the state of equilibrium, established, in time, in a determinate series with acid, alcohol, water, and neutral ether. It now seems to us useful to condense the general results of these experiments. They should be regarded from two points of view. On the one hand we may contrast the statics of etherising reactions, which require time for their development, with the statics of saline reactions, which are accomplished almost instantaneously. On the other hand we may regard the statics of etherising reactions as revealing the laws which regulate the divisions which take place in homogeneous series, and of which the study of saline reactions gives but a vague and incomplete idea.

We will now look at the subject from the first point of view.

1. Let us recall as a point of comparison some of the phenomena which occur in saline reactions. By making a soluble base act on a soluble acid, for instance, potash on acetic or sulphuric acid, 1 equivalent of potash immediately combines with 1 equivalent of acid. If the operation is performed in presence of excess of alkali or of acid, or of a certain quantity of salt which is formed, that is to say, sulphate or acetate of potash, the least abundant body, in any case, enters immediately and entirely into combination. The amount of water in presence of the acid base at the moment of combination has no effect on the result. These statements are the result of ascertained

facts, and are confirmed by the study of calorific effects which take place in saline reactions.

These phenomena characterise not only the reaction of a soluble base on a soluble acid, but likewise the action of a gaseous acid, such as hydrochloric acid on a gaseous base, such as ammonia, whether these two bodies exist either in a gaseous form or in solution. In short, the same phenomena are manifested throughout the homogeneous saline series, provided certain special conditions of insolubility or volatility capable of determining accessory phenomena by destroying the homogenousness of the series are avoided.

2. Now let us examine what takes place in etherising reactions. For instance, by inducing the reaction of ordinary alcohol on acetic acid, these two bodies being capable of admixture in any proportions, and with the products of their reaction. The two bodies combine little by little, and very slowly, and in accordance with the progressive laws set forth; but the reaction effected between 1 equivalent of acid and 1 equivalent of alcohol never attains complete combination. Long before that point the combination is arrested, because it is limited by the action of the water formed in the combination, which tends to decompose the ether already formed. This reciprocal decomposition of a neutral ether, by water in a homogeneous series, represents an order of effects quite dissimilar to those which occur in the reaction of potash on acetic acid.

3. By eliminating the water, the reaction between equal equivalents of acid and alcohol may be completed, the same as in the reaction of an acid on a base. But, under the ordinary conditions, the water intervening, etherification is arrested at a certain limit. The limit of the reaction is determined by fixed conditions; it is nearly independent of temperature and pressure, provided the series remains liquid; it is even almost independent of the state of solution in a menstruum, incapable of acting on one of the component parts of the series.

4. On the contrary, the limit of reaction is not the same in a gaseous as in a liquid system; the combination between acid and alcohol is so much the more complete as the exhaustion of the system is more considerable. In other words, the decomposing action of water on neutral ether is decreased by the expansion more rapidly than the composing action of the acid on alcohol.

5. Hitherto we have surveyed in a general way the reciprocal action of 1 equivalent of alcohol on 1 of acid. This action is modified by the presence either of an excess of acid or of alcohol, primitive components, or of an excess of water or neutral ether, products of the reaction. Nor is this all. According to the theories on etherification generally accepted before our researches, it would seem that the affinities between various acids and alcohols were not exerted in the same manner, and did not attain the same limit. There are here an entirely new set of conditions of equilibrium in the exercise of chemical affinities.

6. One fact first engages our attention. Having induced reaction with equal equivalents of various monobasic acids and monoatomic alcohols, we found that the quantity of neutral ether formed, that is to say the limit, varied very slightly, whatever might be the diversity of equivalents, volatility, or solubility, in short of properties physical and chemical, between these acids and alcohols. The proportion is always comprised between 60 and 70 hundredths, and it oscillates from ⅔rds of 1 equivalent.

The same reaction extends to polyatomic bodies. In fact, the quantity of acid neutralised in the reaction of one equivalent of monobasic acid on one equivalent of polyatomic alcohol (glycerine, glycol, erythrite) is comprised within the same limits as with mono-atomic alcohol. Again, the same holds with the proportion of bibasic* or tribasic acid neutralised by a mono-atomic or polyatomic alcohol. In fact, the equivalent proportion of an acid and alcohol entering into combination, the two bodies being put in contact in equal equivalents, are almost independent of the special nature of the acid and alcohol.

We say *almost*, and not *absolutely*, because comparative experiments on metameric series—that is to say, on series ponderably identical, and the physical properties of which are as similar as possible—do not lead to exactly the same limit, but to values very nearly the same.

7. The relation thus understood is quite general; it applies not only to the case of the acid and the alcohol having equal equivalents, but it is verified also, according to our experiments, whatever the relative proportions of acid and alcohol, whatever may be their properties. This is equally true whatever quantities of water or neutral ether may be added.

Generally, in a series formed of acid, alcohol, neutral ether, and water, in whatever proportions, the limit of the reaction depends almost exclusively on the relations existing between the equivalents of these various bodies; and is almost independent of their individual nature.

The same relation determines the total limit of the reaction, not only in a series containing an acid and an alcohol, but also in a series containing several acids and alcohols. In this case the sum of the equivalents of acids are compared with the sum of the equivalents of alcohols, on the one hand, and on the other with the total quantity or limit of acid neutralised at the moment of equilibrium.

Such is the fundamental law which brings the statics of the etherene reactions of organic chemistry to the equivalents—that is to say, to the same essential datum as the saline reactions of mineral chemistry.

We will now go further into the discussion of the conditions of equilibrium determining the formation and the decomposition of ethers according to the proportions of acid, alcohol, water, and neutral ether. Here are conditions so much the more characteristic in that they apply to a division effected in the homogeneous series, which so remain during the whole of the reactions.

1. One equivalent of acid being put in contact with several equivalents of alcohol, the quantity of ether increases with the number of equivalents of alcohol, although a single equivalent only enters into the reaction. The alcohol acts quite differently to a solvent foreign to the reaction, since the latter would not sensibly modify the limit. The increase resulting from the predominance of alcohol is effected continuously and without any sudden action. The acid thus indefinitely approaches a state of complete combination, because the excess of alcohol tends to weaken the antagonistic influence of the water. Experiment shows that the quantity of uncombined acid, in presence of excess of alcohol, is nearly in inverse ratio to the total quantity of alcohol.

If, on the contrary, the amount of acid is less than one equivalent, the absolute quantity of ether formed is necessarily diminished. The quantity then tends to remain proportional to the weight of alcohol employed, from ½ an equivalent to a very small quantity of alcohol; this explains why, during this interval, the effects of the affinities set in action during the formation of an ether have a tendency to remain proportional to the smallest of the chemical masses entering into the reaction. The proportion, however, is not absolutely fixed, for the series approaches little by little to the state of complete etherification of the alcohol in proportion as it tends to become null in the series. In other words, a trace of alcohol, in presence of an acid, etherifies, so to speak, entirely.

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* With some reservation relative to sulphuric acid.

Polybasic acids and polyatomic alcohols behave under all these circumstances exactly the same as mono-atomic alcohols.

The foregoing statements apply to all possible mixtures of pure alcohol and pure acid; but they are more especially intended to evidence the influence of alcohol on etherification.

To exemplify the influence of acid on the same series of reactions, an inverse point of view must be taken.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, May 6.

"*On the Metal Indium and Recent Discoveries in Spectrum Analysis,*" *by Professor* Roscoe, *F.R.S.*

Since the spring of 1862, when the speaker delivered a course of three lectures in this institution on the spectrum discoveries, much has been done to increase our knowledge of spectrum analysis, but the whole subject is still in its infancy, and the further we advance the more we find remains to be known.

No less than four new elementary bodies have already been discovered by means of spectrum analysis: cæsium and rubidium, by Bunsen; thallium, by Crookes; and indium, by Reich and Richter, of Freiberg; whilst the foundations of solar chemistry, laid by Kirchhoff, have been rendered more secure by the observations of Cooke, in America; Donati, in Italy; and Miller and Huggins, in England.

Cæsium and rubidium were at first only found in one or two mineral waters; they have since been shown to be widely distributed in the vegetable as well as in the mineral kingdom; they have been obtained in considerable quantities from the beet-root salt, and found in the ashes of tea and coffee, thus proving that they occur commonly in soil; whilst, quite recently, M. Pisani has found that a mineral, called pollux, occurring in Elba, contains 34 per cent. of cæsium, this metal having been mistaken for potash in the analyses which had previously been made of this substance. Thallium and its compounds have been obtained in large quantities, and their properties fully investigated by Crookes and Lamy, whilst this metal has not only been found in iron pyrites, but also in large quantities by Schrötter in the mica of Zinnwald, and in lepidolite from Moravia. Thallium has been shown by Boettger to occur together with cæsium and rubidium in the mineral water of Nauheim, near Frankfort; Boettger has, moreover, shown that thallium is contained in the vegetable kingdom, he has found it in the yeast of the vinous fermentation; so that thallium exists in wine; also in treacle, tobacco, and chicory. If 4 lbs. of any of these substances are employed, a sufficient quantity of thallium can be obtained as the double platinum chloride to enable its presence to be easily detected. Professor Bunsen has informed the speaker that he has found a mother liquor from the Hertz, which contains so much thallium that the iodide can be obtained by direct precipitation in quantity at the rate of 10s. per lb. The speaker exhibited the spectrum of the Nauheim salt, which contains the three new elements; the spectrum of each metal is well seen by placing the mixed platino-chlorides in the electric arc.

Drs. Reich and Richter, of Freiberg, in Saxony, have lately discovered a fourth new metal in the Freiberg zinc blende.* This metal has been termed indium, from the two splendid indigo-blue lines which characterise its spectrum. Through the kindness of Professor Richter, the speaker had been placed in possession of a few grains of this new metal, the spectrum of which was exhibited by the electric lamp. In its chemical relations it resembles zinc, with which it is associated in nature; the metal can be reduced before the blowpipe to a malleable bead, when it forms a soft, ductile bead, which imparts streaks to paper on rubbing, and possesses a colour lighter than that of lead, being about the same as that of tin. The metallic bead dissolves in hydrochloric acid, with the evolution of hydrogen. The oxide of indium is formed as a yellow fusible incrustation when the metal is heated before the blowpipe on charcoal. Indium differs from zinc in the insolubility of the hydrated oxide in excess of both ammonia and caustic potash. This new element may be separated from all the known metals by precipitating its sulphide in alkaline solution, and by throwing down the hydrated oxide, first with ammonia and then with caustic potash; and, lastly, by precipitating the iron with dilute solution of bicarbonate of sodium. The hydrated oxide of indium then remains in solution in the pure state. Indium may be readily detected when present in its pure compounds by the deep purple tint which these impart to flame. The characteristic lines are, however, best seen when a small bead of indium salt is placed between two poles, from which an electric spark passes; the lines In α and In β fall respectively upon divisions 107·5, and 140 of the photographic scale of the spectroscope, when Na = 50, and Sr δ = 100·5. Up to the present time indium has been only found in the very smallest quantity, and hence the atomic weight of the metal and the composition of its salts have not yet been determined; in fact, the speaker was led to infer that Professor Richter sent him nearly all the compound of the metal remaining from the investigation of its properties, for the purpose of illustrating this discourse. It has only as yet been detected in the zinc blende of Freiberg; but it will, doubtless, soon be discovered in larger quantities, and its compounds more closely studied.

As regards the spectra of the well-known metals, our knowledge has been much increased by the publication of the second series of Kirchhoff's maps of the solar spectrum and the spectra of the chemical elements (Macmillan and Co.). In these Kirchhoff has marked the position of the bright lines of no less than thirty metals, and indicated those which, as they coincide with a dark solar line, reveal the presence of the particular metal in the sun's atmosphere. Kirchhoff's maps now embrace the whole of the visible spectrum from the line A in the extreme red to the line G in the indigo; beyond these limits the intensity of the light passing through his three prisms became too slight to enable him to draw the lines. The observations thus made of coincidences of metallic with solar lines in the red and indigo portions of the spectrum, confirm the conclusions drawn by Kirchhoff from his earlier observations, with the exception of the presence of potassium. This metal is not seen in the solar atmosphere, the potassium red line is not coincident with the solar A, as it was supposed to be, nor with any other dark solar line. No metal, in addition to those previously observed, was found to possess lines coincident with solar lines, and hence the number of bodies known to be present in the sun has not been increased.

The experiments of Mr. Hoggins on the spectra of the metallic elements, made with an instrument of six prisms, although not yet published in full, promise to add greatly to our knowledge on this subject; one interesting observation may be cited, viz.: that the spectrum of sodium has been found to contain three pairs of lines in addition to those corresponding to the dark double line D, and that these also coincide with dark solar lines, adding to the evidence previously possessed of the existence of sodium in the sun. The audience had been already made acquainted with Dr. Miller's important researches on the photographic spectra of the metals, and with the valuable observations made by himself and Mr. Huggins on the spectra of the fixed stars. Connected with this part of the subject may be mentioned Professor Stokes's interesting investigation on the long spectrum of the electric spark, in which he shows that the vapour of certain metals, such as iron and magnesium, when heated by the passage of an electric spark, emit rays of so high a degree of refrangibility that they are situated at a distance from the lines H, ten times as great as that of the whole visible spectrum from A to H. These highly refrangible rays only become visible at the highest temperatures, and they are not seen in the solar spectrum, although the less refrangible iron and magnesium lines are present. Hence it has been suggested that the temperature of the sun must be lower than that of the electric spark in which these lines are developed. This conclusion appears legitimate only if we know that these rays of high refrangibility are not absorbed in passing through our atmosphere; and an investigation of great interest here presents itself for those who ascend into the higher regions of the atmosphere.

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* *Phil. Mag.* for March, 1864. Series 4, vol. xxvii. p. 199.

The observations of Dr. Robinson upon metallic spectra have led this astronomer to doubt the validity of some of the conclusions arrived at by Kirchhoff concerning the existence of a separate and non-coincident set of lines in the spectrum of each metal. It seems, however, that Dr. Robinson employed only one prism and a low magnifying power, so that we must conclude that the observations from which he deduces the coincidence of certain lines as proving their identity in several metals, cannot impugn the results obtained by help of a larger instrument of sufficient power to resolve these apparent coincidences.

The original statement made by Bunsen and Kirchhoff concerning the spectra of the metals still remains unopposed by a single well-established fact—the statement namely, that when a metal is heated up to a certain point, the spectrum of its incandescent vapour contains a number of fine bright lines which do not change their position with increase of temperature, and are not coincident with the lines of any other known substance. There is, however, no doubt of the fact that in the spectra of certain metals or metallic compounds new lines are developed by increase of temperature; and also that certain metals, as calcium, barium, and strontium, yield spectra of two kinds; one of these, seen at the lower temperature, and consisting of broad bands, being resolved at a higher temperature into bright lines. These bright lines do not undergo any further change on elevation of temperature, and characterise the true metallic spectrum, whilst the band-spectrum is probably produced by the incandescent vapour of a metallic compound which is decomposed at a higher temperature.

Our knowledge of the spectra of the non-metallic elements is, as yet, in a very incomplete state. To the researches of Plücker we are especially indebted for information on this subject; he has shown that each metalloid possesses a peculiar and characteristic spectrum; hydrogen, for instance, yielding only three bright lines, all of which are coincident with dark solar lines; and nitrogen exhibiting a complicated series of bands. Plücker has lately come to the conclusion that many non-metallic elementary bodies, and among them sulphur and nitrogen, exhibit two distinctly different spectra when the temperature is altered, in this respect resembling the metals of the alkaline earths. This difference Plücker ascribes to the existence of these elements in two allotropic conditions.

A singular relation with regard to what have been termed the carbon lines was observed by the speaker. It has been stated that all the various forms of carbon compounds when in the state of incandescent gas, yield identical spectra. This proves not to be the case; the spectrum obtained from the flame of olefiant gas is different from that obtained by the electric discharge through a vacuum of the same gas; whilst the spark passing through a cyanogen vacuum produces a spectrum identical with that of the olefiant gas-flame, and through the carbonic oxide vacuum a spectrum coincident with that of the spark through olefiant gas vacuum.

As an illustration of the application of abstract scientific principles to useful practical purposes, the speaker stated that he had lately applied spectrum analysis to the manufacture of steel by the Bessemer process. One of the great drawbacks to the successful practical working of Mr. Bessemer's beautiful process for converting cast-iron directly into steel has been the difficulty of determining the exact point at which the blast of air passing through the molten metal is to be stopped. The conversion of five tons of cast-iron into cast-steel usually occupies from fifteen to twenty minutes, according to the varying conditions of weather, quality of the iron, strength of the blast, &c. If the blast be continued for ten seconds after the proper point has been attained, or if it be discontinued ten seconds before that point is reached, the charge becomes either so viscid that it cannot be poured from the converting vessel into the moulds, or it contains so much carbon as to crumble under the hammer. Up to the present time, the manufacturer has judged of the condition of the metal by the general appearance of the flame which issues from the mouth of the converting vessel. Long experience enables the workman thus to detect, with more or less exactitude, the point at which the blast must be cut off. It appeared to the speaker that an examination of the spectrum of this flame might render it possible to determine this point with scientific accuracy, and that thus an insight might be gained into the somewhat complicated chemical changes which occur in this conversion of cast-iron into steel. At the request of Messrs. John Brown and Co., of the Atlas Works, Sheffield, the speaker investigated the subject, and succeeded in obtaining very satisfactory and interesting results. The instrument employed was an ordinary Steinheil's spectroscope, furnished with photographic scale and lamp, and provided with a convenient arrangement for directing the tube carrying the slit towards any wished-for part of the flame, and for clamping the whole instrument in the required position. By help of such an arrangement the spectrum of the flame can be most readily observed, and the changes which periodically occur can be most accurately noted.

The light which is given off by the flame in this process is most intense; indeed, a more magnificent example of combustion in oxygen cannot be imagined; and a cursory examination of the flame-spectrum in its various phases reveals complicated masses of dark absorption bands and bright lines, showing that a variety of substances are present in the flame in the state of incandescent gas. By a simultaneous comparison of these lines in the flame-spectrum with the well-known spectra of certain elementary bodies, the speaker has succeeded in detecting the presence of the following substances in the Bessemer flame:—Sodium, potassium, lithium, iron, carbon, phosphorus, hydrogen, and nitrogen.

A further investigation with an instrument of higher dispersive and magnifying powers than that employed will doubtless add to the above list; and an accurate and prolonged study of this spectrum will probably yield very important information respecting the nature of the reactions occurring within the vessel. Already the investigation is so far advanced that the point in the condition of the metal at which it has been found necessary to stop the blast can be ascertained with precision; and thus, by the application of the principles of spectrum analysis, that which previously depended on the quickness of vision of a skilled eye has become a matter of exact scientific observation.

Another interesting practical application of our knowledge concerning the properties of the kind of light which certain bodies emit when heated is the employment of the light evolved by burning magnesium wire for photographic purposes. The spectrum of this light is exceedingly rich in violet and ultra-violet rays, due partly to the incandescent vapour of magnesium, and partly to the intensely-heated magnesia formed by the combustion. Professor Bunsen and the speaker in 1859 determined the chemically active power possessed by this light, and compared it with that of the sun; and they suggested the application of this light for the purpose of photography. They showed[†] that a burning surface of magnesium wire, which, seen from a point at the sea's level, has an apparent magnitude equal to that of the sun, effects on that point the same chemical action as the sun would do if shining from a cloudless sky at a height of 9° 53′ above the horizon. On comparing the visible brightness of these two sources of light, it was found that the brightness of the sun's disc, as measured by the eye, is 524·7 times as great as that of burning magnesium wire when the sun's zenith distance is 67° 22′; whilst at the same zenith distance the sun's chemical brightness is only 36·6 times as great. Hence the value of this light as a source of the chemically active rays for photographic purposes becomes at once apparent.

Professor Bunsen and the speaker state in the memoir above referred to that "the steady and equable light evolved by magnesium wire, burning in the air, and the immense chemical action thus produced, render this source of light valuable as a simple means of obtaining a given amount of chemical illumination, and that the combustion of this metal constitutes so definite and simple a source of light for the purpose of photo-chemical measurement that the wide distribution of magnesium becomes desirable. The application of this metal as a source of light may even become of technical importance. A burning magnesium wire of the thickness of 0·297 millimetre evolves, according to the measurement we have made, as much light as 74 stearine candles, of which five go to the pound. If this lighted lasted one minute, 0·987 metre of wire, weighing 0·120 grammes, would be burnt. In order to produce a light equal to 74 candles burning for ten hours, whereby about 20 lbs. of stearine is consumed, 72·2 grammes (2½ ounces) of magnesium would be required. The magnesium wire can be easily prepared by forcing out the metal from a heated steel press having a fine opening at bottom; this wire might be rolled up in coils on a spindle, which could be made to revolve by clockwork, and thus the end of the wire, guided by passing through a groove or between rollers, could be continually pushed forward into a gas or spirit lamp flame in which it would burn."

It afforded the speaker great pleasure to state that the foregoing suggestion had now been actually carried out. Mr. Edward Sonstadt has succeeded in preparing magnesium on the large scale, and great credit is due to this gentleman for the able manner in which he has brought the difficult subject of the metallurgy of magnesium to its present very satisfactory position.

Some fine specimens of crude and distilled magnesium weighing 3 lbs. were exhibited, as manufactured by Mr. Sonstadt's process, by Messrs. Mellor and Co., of Manchester.

The wire is now to be had at the comparatively low rate of 3d. per foot,[‡] and half an inch of the wire evolves on burning light enough to transfer a positive image to a dry collodion plate, whilst by the combustion of 10 grains a perfect photographic portrait may be taken, so that the speaker believed that for photographic purposes alone the magnesium light will prove most important. The photochemical power of the light was illustrated by taking a portrait during the discourse. In doing this the speaker was aided by Mr. Brothers, photographer, of Manchester, who was the first to use the light for portraiture.

ACADEMY OF SCIENCES.

June 13.

A MEMOIR by M. Wurtz announces that he has formed hexylene by the action of sodium on the dihydriodate of diallyl. Several other hydrocarbons with high boiling points were formed at the same time. Hexylene distils between 68° and 70°; another hydrocarbon, $C_{12}H_{22}$, formed in the reaction, distilled between 190° and 200°.

M. V. de Luynes presented a memoir "*On the Hydriodate and Hydrate of Butylene*," which he describes as isomeric with the iodide and hydrate of butyle.

The French chemists are still busy with various theories and experiments on fermentation. Two notes read at the last meeting were on this subject, but offer nothing to report.

M. Lefort claims priority of discovery in the method of separating digitaline by dialysis, alluded to last week. He deposited a sealed paper with the Academy some time ago describing the process and some reactions of digitaline. Some remarks on different kinds of digitaline in use in France we shall append to the paper of M. Grandeau, which we shall shortly publish.

NOTICES OF BOOKS.

Annalen der Chemie und der Pharmacie. May, 1864.

MOST of the papers in this Journal relate to organic chemistry, and are of little general interest. They include Researches on the Uric Acid Group, by A. Baeyer; a second communication on Menthol, by A. Oppenheim; a paper on Acrolein-ammonia, and a new base obtained from it by distillation by Dr. Claus; some observations on Tartramide and Tartramimic Acid, by K. Grote, who also gives an analysis of Cystin, and some remarks on Azelic Acid. To cystin this author assigns the formula $C_6H_7NS_2O_4$, that is, one more atom of hydrogen than former experimenters found. Erdmann describes a new basis from Valeral-ammonia, and Strecker some compounds of Valeraldehyd. Schoyen communicates a method of obtaining butyric acid by synthesis, and Beilstein a paper on reduction of nitro-bodies by tin and hydrochloric acid. Among the articles to which we may return is one on the quantitative estimation of uric acid by Heintz, and another on the purification of arsenical sulphuric acid by Buchner, who removes arsenious acid by passing chlorine through hot sulphuric acid. Should arsenic acid be present, he reduces this to arsenious acid by heating the sulphuric with a piece or two of charcoal, and then passes the chlorine; the two operations may be conducted simultaneously. Natanson gives a very delicate test for protosalts of iron, which consists in adding a solution of rhodianate potash to the iron solution, and then shaking it up with a little ether. The ether becomes rose-coloured or blood red according to the amount of iron. Fehling makes known that he has found a crystallised double carbonate of soda and potash—

$$KO,NaO,C_2O_4 + 12HO.$$

This salt was obtained from a saltpetre manufactory, and also from a prussiate of potash factory.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following paper will be read:—"On the Philosophy of Agriculture," by Mr. J. T. Way.

[†] Phil. Trans. 1859, p. 920.

From Messrs. Johnson and Matthey, of Hatton Garden.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

357. Jean Marius Faget, Bordeaux, France, "Improved apparatus for taking up the emanations and the gases from boilers.—Petition recorded February 11, 1864.

1310. John Harcourt Brown, Strand, Westminster, "Improvements in treating animal substances for the manufacture of size, pulp, and pulpy matter, and converting the said pulp or pulpy matter into sheets, slabs, blocks, thread, hollow or tubular articles, and such other articles of commerce for which the said sheets, slabs, blocks, threads, hollow or tubular articles may be applicable."—Petition recorded May 26, 1864.

Notices to Proceed.

280. John Hawkins, Walsall, Staffordshire, and Charles Hawkins, Selly Oak, Worcestershire, "Improvements in the manufacture of gas for illumination and other purposes, and in apparatus connected with the same."—Petition recorded February 2, 1864.

299. James Young, Bucklersbury, London, "Improvements in the preservation of vegetable and animal matters."—Petition recorded February 4, 1864.

301. Eugen Lucius, Frankfort-on-the-Maine, Germany, "Improvements in the separation and purification of colours."

307. Robert Owen, Manchester, Lancashire, "Improvements in apparatus for filtering water and other liquids."—Petitions recorded February 5, 1864.

340. William Clark, Chancery Lane, Middlesex, "Improvements in apparatus for inhaling air when charged with vapours."—A communication from Charles Pierre Baillemont, Boulevard St. Martin, Paris.

341. Brereton Todd, Falmouth, Cornwall, "Improvements in compositions to be used to prevent the oxidation of iron, the fouling of ships' bottoms, and other submerged things, and also preserving wood from decay and worms."

342. Angier March Perkins, Francis Street, Regent's Square, Middlesex, "Improvements in warming rooms and buildings."

346. Peter Spence, Newton Heath, Lancashire, "Improvements in the manufacture of sulpho-cyanide of ammonium and other sulpho-cyanides."—Petitions recorded February 9, 1864.

403. James Wadsworth, Heaton Norris, Lancashire, "Improvements in the methods of softening or dissolving bone, horn, hair, leather, curriers' shavings, raw hide scraps, wool, woollen rags, or other animal matters."—Petition recorded February 17, 1864.

621. Hugh Simester, New Street, Dorset Square, and John Bainbridge, Ely Place, Middlesex, "Improvements in register stoves or fireplaces and furnaces conducing to the consumption of smoke, and applicable tó warming, ventilating, cooking, and other purposes."—Petition recorded March 12, 1864.

1325. John William Lees, Waterhead Mill, near Oldham, Lancashire, "Certain improvements in the method of cleaning and preventing the formation of deposits upon the heating apparatus employed in boilers for generating steam."—Petition recorded May 28, 1864.

CORRESPONDENCE.

The Silicates of Thallium and Alkalies.

To the Editor of the Chemical News.

Sir,—Having from time to time taken much interest in the researches into the uses and properties of thallium which have appeared in the Chemical News, I have often thought of suggesting an investigation into the silicates of thallium compounds, of which I have hitherto seen no notice or hint in any publication.

It would be very interesting, and probably of practical importance, to ascertain how far its properties are available for producing new tints in glass staining, &c. But what would make the subject of more immediate interest to me would be to learn the behaviour of the soluble salts of thallium with pure solutions of the alkaline silicates, and the re-solution of the gelatinous precipitates in the concentrated solutions of silicates of soda, &c.

The solubility of the gelatinous precipitates of all silicates in solutions of the alkaline silicates I claim as a discovery of my own, and with the greater confidence as there is no hint in the investigations of Fuchs and of Khallmar of this property; no mention of it in the Chemical News, except in connection with my invention; no mention of it in Dr. Percy's lectures, now appearing in your publication; no recognition of it in Liebig's "Agricultural Chemistry," although the explanation of the structure of rocks must be imperfect without a recognition of it, and agricultural chemistry necessarily modified in accordance with it.

If the subject be of that importance which I deem it to be, the insertion of these few lines in the Chemical News will, no doubt, soon set those who are most competent in the field of science to pursue the investigation both in its practical and scientific bearing. I am, &c.

Henry Ellis.

Bangor, June 18.

[We believe it is a well-known and obvious fact that gelatinous silica will dissolve in an alkaline silicate.—Ed. *C. N.*]

ANSWERS TO CORRESPONDENTS.

⁂ *We have the pleasure of informing our readers that we have made arrangements with an eminent scientific writer to supply the* Chemical News *with a weekly letter from Paris, which will contain all the Continental scientific news down to within a day or two of publication. Besides being acquainted with most of the Parisian* savans, *the writer in question has peculiar facilities for obtaining scientific information, being connected, in a literary capacity, with two of the leading scientific journals of Europe. The first letter will appear in our next number, commencing Vol. X. We shall at the same time commence a series of Lectures by Professor Wurtz, delivered before a popular audience. In these will be found a clear and original exposition of the principles of chemical science. Dr. Crace Calvert's Cantor Lectures are being rewritten for the* Chemical News *by the author, and will be commenced early in the volume.*

In our notices of books we shall greatly enlarge the plan we have recently adopted of giving a resumé *of the contents of foreign journals, so as to lay before our readers an analysis of the contents of the leading scientific journals in Europe as they appear.*

Arrangements are also being made by which we shall publish a greater number of original articles in scientific, technical, and pharmaceutical chemistry, and in physical science.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E C.

T. N.—Your questions shall receive an answer next week.

Studiosus.—Received. Shall appear next week.

Sodium.—It is soluble to any extent. An excess of alkali favours the solution.

J. Austin.—We know no better way.

G M.—1. Use soda ash. 2. Apply to Mr. Harrison, bookseller, Pall-mall, London.

R. L. S.—1. The reference to the original is given at page 66, but the essay is now published in a separate form, and may be had of a French bookseller. 2. We are unable to give you more information on this matter. You will no doubt find an abstract of the paper in the Proceedings of the Belgian Academy.

Received.—B. Werington.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Analysis of Mineral Phosphates, by R. WARINGTON, *jun., F.C.S., Assistant to Professor* CHURCH, *Royal Agricultural College, Cirencester.*

THE minerals which are at the present time chiefly resorted to as sources of phosphoric acid are apatite, guano, and coprolite. The analysis of some of these, as of the purer forms of apatite, and of Peruvian guano, presents but little difficulty, at least when the commercial value of the mineral is the object in view, but when we come to substances like coprolite, or the curious altered guano known as sombrerite, the case is different. These minerals generally contain a considerable amount of oxide of iron and alumina, besides lime, magnesia, &c., and we have to solve the serious problem of the estimation of phosphoric acid in the presence of these bases, as well as their separation from each other.

On consulting standard manuals of analysis, it is presently seen that very few of the processes there recommended for the determination of phosphoric acid are here applicable. The molybdic acid method is inadmissible from the large amount of phosphoric acid to be determined. The mercurial method fails us owing to the presence of alumina. The uranium method is equally unavailable from the presence of iron, or can be employed only if the iron be previously reduced by means of protochloride of uranium. The tin method is free from all these objections, and is no doubt, when carefully conducted, an excellent process, but the time it takes up is considerable, and it appears for other reasons to be unfitted for very general use.

Different methods have been employed by individual chemists, but none have proved so eminently satisfactory as to be extensively adopted. In this state of the case, the result of some experiments recently made in this laboratory may not be unacceptable to the agricultural analyst.

The subject divides itself into two parts, the estimation of phosphoric acid and of the alkaline earths, and the estimation of oxide of iron and alumina. In the first part of the subject we have to describe two methods, which were found to yield satisfactory results, the first has not, I think, previously been employed in the analysis of ferruginous phosphates.

The nitric acid solution* of the mineral, previously freed from silica in the usual way, is treated cautiously with dilute ammonia to remove all unnecessary excess of acid, the clear liquid is then treated in one of two ways; either an excess of neutral acetate of lead is added, or the solution is treated with nitrate of lead, and digested with successive portions of finely-powdered litharge till slightly alkaline, the liquid in this case being finally acidified with a few drops of acetic acid. The former plan is generally to be preferred, though the precipitate is considerably more bulky, as only a portion of the iron, and probably none of the alumina, is in this case precipitated with the phosphoric acid.

The precipitated phosphate of lead is warmed for some minutes to induce aggregation, and then thoroughly washed by decantation, the washings being filtered. The washing water should be slightly warm, and contain a little acetate of ammonia, otherwise the filtrate is apt to be turbid.

There are several ways of treating the precipitate: it may be dissolved in nitric acid (which, for this purpose, must not be too weak), the solution diluted, and the lead precipitated by means of sulphuretted hydrogen; or the nitric solution may be treated with an excess of sulphuric acid, and the lead precipitated as sulphate. The first plan is unexceptionable, and yields excellent results; the necessary dilution entails, however, a subsequent concentration, which occupies some time. If acetate of lead has been used, perhaps the best plan for ordinary purposes is to treat the phosphate of lead with oxalic acid and a few drops of oxalate of potash. The decomposition is rapid and complete; the oxalate of lead may, after a short time, be separated by filtration. Oxalic acid does not perfectly decompose the highly aggregated precipitate obtained with nitrate of lead and litharge. The action of sulphuric acid on the precipitate is incomplete, whether nitrate or acetate of lead has been employed. Oxalate of lead is nearly insoluble in oxalic acid; its solution, if treated with sulphuretted hydrogen water, appears only very slightly discoloured when looking through a depth of several inches.

The lead being separated, the solution now contains the whole of the phosphoric acid, with a little iron; some citric acid is added, and an excess of ammonia; the clear solution is finally treated with magnesia mixture, and the phosphoric acid separated in the usual way.

The lime, magnesia, and alkalies are readily determined in the original filtrate from the phosphate of lead, the excess of lead being first precipitated by means of sulphuretted hydrogen. A little citric acid must be added before the solution is made ammoniacal for the determination of magnesia, to hold in solution the oxide of iron and alumina.

This method has the advantage of speed, and admits of the convenient determination of all the bases except iron and alumina; its accuracy has been carefully tried by operating on artificial mixtures of known composition. The results were very satisfactory.

The next method we have to describe is an old one. It is not adapted, like the preceding, to form part of a complete analysis, as the magnesia and alkalies cannot be conveniently determined; it will be found, however, when conducted as here described, a very good method for commercial purposes; it gives the best results when the amount of oxide of iron and alumina present is but small.

The acid solution of the mineral after separating silica, is cautiously treated with dilute ammonia till a slight permanent opalescence is produced; a drop or two of oxalic acid is then added, and the fluid allowed to stand; the opalescence will disappear, and the solution, if iron is present, will become yellow. An excess of oxalate of ammonia is now added, and the fluid warmed for some time to aggregate the oxalate of lime, which is then collected on a filter. The filtrate is concentrated, some citric acid added, and ammonia in excess, the phosphoric acid is then precipitated with magnesia mixture.

The oxalate of lime obtained will be found quite free from phosphoric acid; its amount, however, will be a little below the truth, from the partial solubility of oxalate of lime in oxalic acid. If to avoid this error, we attempt to neutralise the liquid before collecting the lime, phosphate of iron and alumina fall with the precipitate. The deficiency of lime amounted in the experiments to rather less than half a per cent.; the precipitate of phosphate of magnesia is not, however, in excess to that amount, as the citric acid not only holds in solution oxide of iron and alumina, but also, to some extent, oxalate of lime[†]. A trace of lime will, nevertheless, always be found in the magnesia precipitate, not, however, sufficient to vitiate the result for any ordinary purpose, if the operation has been properly conducted.

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* When nitric acid alone is used to effect the solution of a coprolite a trace of phosphoric acid is sometimes left with the silica; it is therefore safest to dissolve in hydrochloric acid, and after the evaporation to dryness to redissolve with nitric acid.

Citric acid should in every case be preferred to tartaric, on account of the superior solubility of its compounds with magnesia[‡].

It has been suggested that oxalate of magnesia, being a sparingly soluble salt, is likely to fall with the phosphate, and also that fluoride of magnesium when present would be precipitated. These two sources of error appear, however, to be removed by the presence of citric acid. In experiments on the point no precipitate of these salts was obtained when citric acid was present, though occurring readily in its absence. The use of a great excess of magnesia is, however, always to be avoided.

We turn now to the second part of our subject, the determination of alumina and oxide of iron; this has to be effected in a separate analysis. One of the advantages promised by the tin method already referred to, is, that it admits of the determination of all the bases in one portion. We find, however, a hint in Fresenius that if much iron is present, a portion of this is held by the binoxide of tin. In experiments made with this method 3 per cent. only of oxide of iron was obtained from a coprolite known to contain 5 per cent.; the alumina was apparently unaffected. This is particularly unfortunate, as the separation of phosphoric acid by the tin leaves the bases all as nitrates, and consequently admitting of easy separation.

Alumina is best determined by precipitating the acid solution with excess of caustic soda, digesting for some time, and finally separating the clear fluid by decantation and filtration. The solution contains the alumina plus phosphoric acid. The phosphoric acid is easily removed by treating cautiously with chloride of barium till it ceases to produce a precipitate. A little carbonate of soda is then added to remove the excess of baryta; lastly, some more caustic soda. The whole is warmed and filtered. The alumina is separated from the filtrate in the usual way.

The original precipitate by soda contains the whole of the iron. This is best determined by the volumetric method with permanganate of potash. If, however, a gravimetric determination is desired, we proceed as follows:—The precipitate containing the mixed oxide of iron and phosphate of lime is dissolved in hydrochloric acid, a slight excess of ammonia added, and finally a considerable excess of acetic acid. The fluid is gently warmed for a few minutes. The precipitated phosphate of iron is then thoroughly washed by decantation. Thus obtained, the phosphate of iron always contains a portion of phosphate of lime. Nearly the whole of this may be got rid of by redissolving the precipitate and treating with ammonia and acetic acid as before. The precipitate may then be collected; its formula is $Fe_2O_3\,PO_5$. The following is perhaps a more strictly accurate method of procedure. The washed phosphate of iron is dissolved in a small quantity of oxalic acid, a little oxalate of potash added, and the whole warmed. Any oxalate of lime formed is separated by filtration, and the filtrate boiled for some time with a considerable excess of caustic potash. The precipitate consists of pure oxide of iron, the potash having removed the whole of the phosphoric acid.[§] The oxide of iron is to be thoroughly washed by decantation, redissolved, precipitated by ammonia, collected, and weighed. The results are accurate.

Lime and magnesia may, if it is wished, be determined in the filtrate from the phosphate of iron.

The processes we have now mentioned have all been carefully tested, both qualitatively and quantitatively. Many of the reactions treated of are probably quite familiar to the readers of the CHEMICAL NEWS; the detailed description has, however, seemed necessary to give a complete view of the subject. In conclusion, I must express my obligations to Mr. C. Jacobsen, a graduate of the College, for his valuable assistance in these experiments.

Researches on Oxygen, by Dr. G. MEISSNER.

OUR attention has been called to a book with the above title;[‖] the contents are so important as to deserve more than an ordinary review. We propose, therefore, to give as concisely as possible an abstract of parts of the work, so that our readers may have clearly before them the views of the author, and the experiments by which they are supported.

We may pass over the introduction—in which the author gives a rapid sketch of the history of Schonbein's discoveries, and the researches of other chemists on ozone —and pass at once to the chapter on "Electrised Oxygen."

The apparatus used by Dr. Meissner was a modification of an instrument by Siemens, recommended by Von Babo. It is constructed as follows:—Twelve very fine copper wires, about five decimetres long, are each inserted into a very thin glass tube a little longer than the wire, and about 0·33 millimetres in diameter. Each of these tubes is sealed at one end, and at the other end is fused a thin platinum wire, which is twisted with the copper wire within the tube, and projects some centimetres outside the tube. The twelve tubes thus made are arranged within a larger glass tube seven millimetres wide and six decimetres long, so that the projecting platinum wires of six of them are at one end, and those of the other six are at the other end of the wide tube. These two sets of wires are each twisted about a larger platinum wire, which passes through and is fused into the wall of the wide tube. The tubes of the one bundle are distributed as equally as possible among those of the other, and placed in close contact, so that the spaces surrounding them may be as narrow as possible. [An excellent drawing of this apparatus accompanies the book.]

When the ends of these larger platinum wires are connected with the secondary coil of a powerful induction apparatus, the discharge takes through the walls of the smaller tubes, and through the air which surrounds them. The passage of the electricity takes place without sparks, and with very little noise. On approaching the ear only a faint crackling noise is heard. In the dark the bundle of small tubes is seen to be illuminated through its whole length with a reddish-violet light.

It is obvious that in the above-described apparatus platinum wires may be used through the whole system.

By the passage of the electricity the air surrounding the small tubes is strongly ozonised, and by means of a suitable arrangement this ozonised air may be removed for examination and fresh supplied. The author effected this by the pressure of a gasometer.

[†] Spiller. *Quart. Journ. Chem. Soc.*, x. 110.

[‡] *Jour. Chem. Soc.*, I. 304.

[§] Northcote and Church. *Quart. Jour. Chem. Soc.*, vi., 53.

[‖] "Untersuchungen über den Sauerstoff;" von Dr. G. Meissner, Professor in Göttingen. Hanover. Hahn'sche, Hofbuchhandlung. 1861.

In the course of the experiments it was found to be necessary that the air should be perfectly dried before it was electrised. Some difficulty was experienced in accomplishing this, but the author succeeded at last by using next the gasometer a wide tube over a metre long, filled with pieces of chloride of calcium, and then two or three tubes together at least one or one and a half metres long, filled with coarse glass powder drenched with English sulphuric acid. The perfectly dried air, after passing through the ozoniser, was submitted to reagents in receivers of glass connected with the ozoniser by means of mercury joints, this metal being unaffected by dry ozone. [This part of the apparatus is also figured in the book.]

The first point the author set about investigating was whether, besides the formation of ozone, any other changes were produced in oxygen by the passage of electricity. He found that when the ozonised air was passed through a strong solution of iodide of potassium it was deprived of every trace of ozone; but when this deozonised air was passed through pure water, it reappeared as a thick white mist, sometimes so thick as to render the surface of the water quite opaque. The mist resembles that formed by the cooling of steam. Temperature seemed to have no perceptible effect on the mist, as it was formed equally when the air was at 35° and 0° C. It appeared also when the air passed merely through a moistened tube, and sometimes when it escaped from a weak solution of iodide of potassium. But when the solution of iodide was concentrated, and especially when the air was afterwards passed through a chloride of calcium tube, no mist appeared until the air again came in contact with water, showing that a certain amount of aqueous vapour is necessary to its formation.

The appearance of the mist ceases directly the induction apparatus ceases to work, and is denser or lighter according as the electrical action is vigorous or weak. It is seen just as well when pyrogallic acid or other deozonising agents are used in place of iodide of potassium, and moreover is formed when the dry electrised air comes at once in contact with water.

Pure oxygen, however procured, when electrised in the same way, gave the same appearance, while hydrogen and nitrogen suffered no change. The author was thus led to the conclusion that when oxygen is electrised another modification is produced simultaneously with ozone, which he naturally concluded was Schönbein's antozone. He failed at first to establish the identity, and therefore gave the name *atmizone* (ατμιζω—I smoke or fume) to this smoke-forming modification of oxygen. In the end, however, his researches left no doubt of the identity of atmizone with antozone.

(To be continued.)

Has Each of the Four Atoms of Hydrogen in CH_4, the Simplest Hydrocarbon, the same Function? by J. Alfred Wanklyn.

A similar question has often been asked respecting ammonia, and the answer to the one will have an obvious bearing on the answer to the other.

It will be admitted that the finding of different compounds in which an equivalent of the hydrogen is replaced by the same monatomic element will settle the point in the negative.

Such cases are easily found. Substitution by bromine furnishes one example.

Bromide of methyl boils at 13° C. It is obtained by the action of bromine and phosphorus upon methylic alcohol. Any doubt that we might have about the real boiling point of the bromide of methyl will be removed by the consideration that the boiling point of bromide of ethyl is well known (40° C.), and that 13° C. is just about the calculated boiling point for the corresponding methyl compound.

A compound isomeric with bromide of methyl was obtained by Bunsen from the brom-hydrate of kakedylic acid. This compound is a gas. It condenses at about — 17° C.

$$\mathrm{C}\left\{\begin{matrix}\mathrm{H}\\ \mathrm{H}\\ \mathrm{H}\\ \mathrm{Br}\end{matrix}\right. \text{ boils at } 13^\circ \text{ C.}$$

$$\mathrm{C}\left\{\begin{matrix}\mathrm{H}\\ \mathrm{H}\\ \mathrm{Br}\\ \mathrm{H}\end{matrix}\right. \text{ boils at } -17^\circ \text{ C.}$$

Chlorine substitution also gives different compounds. Thus, chloride of methyl obtained by means of methylic alcohol, chloride of sodium, and sulphuric acid is different from the body obtained by acting upon marsh gas by means of chlorines.

Bayer has found the chloride of methyl prepared according to the former process dissolves in water at 14° C. to the extent of 4·172 times (*i.e.*, one volume of water dissolves 4·172 volumes of the gas).

The compound prepared from marsh gas, on the other hand, is dissolved only to the extent of 0·08 at 14° C. Moreover, the former of these bodies forms a crystalline hydrate with water, the latter none. (See Bayer's paper.)

We are, therefore, forced to admit that the hydrogen in the most simple hydrocarbon has not all of it the same function; and since there is an isomer of the bromide and of the chloride of methyl, we should expect to find an isomer of methyl alcohol itself.

London Institution, June, 1864.

*On the Determination of Solubilities,** *by* Frank H. Storer.

The term "solubility" is to be taken in its most comprehensive sense. I have no intention of attempting a strict definition of the word, or of discussing the forces upon which solution may depend. In the present state of science, the collection of experimental data, and the study and comparison of well-authenticated special observations, seem to be of far greater importance than the disputes of the earlier chemists whether the phenomena in question should be referred to the domain of chemical affinity, or be studied as a purely physical problem.† It need only be remarked that I am accustomed to class among phenomena of solubility all those reactions of liquids upon solid bodies, and those combinations of liquids with liquids—excluding, for the present, molten metals and other substances in a state of igneous fusion—in which the chemical force as understood by Berzelius, for instance, is not the principal, and, as it were, overwhelming force in action; we may have, perhaps, "solution" depending upon merely physical forces, like adhesion or cohesion, and also upon these forces *plus* a certain amount of chemical force. It can, indeed, hardly admit of a doubt that the chemical force is exerted in many cases of solution, while, at the same time, other forces unquestionably come into play, in which connection the old adage that "like dissolves like" should be borne in mind. Hence, while the manifestations of chemical affinity proper, as evinced by the combination of bodies in simple and definite proportions, constitute the main subject of chemical text-books, many of the less clearly defined phenomena of chemical science may fairly come within the scope of a treatise on solubilities. Thus, though in the term "solubility of a substance" we ordinarily include only the comportment of the substance towards water, alcohol, wood spirit, ether, oil of turpentine, benzin, and analogous hydrocarbons, and the other "neutral solvents," it is obviously sometimes proper to add observations on the action of acids and alkalies; for example, any account of the solubility of nitrate of baryta would be manifestly incomplete without a statement of the fact that this salt is taken up but sparingly by nitric acid. Again, in the solution of chloride of silver in ammonia water, and that of various salts—as sulphate of lime, for example, in acids—there are probably at work other forces than the usual solvent power; but until the whole theory of solution is better understood we must be content to treat of these allied phenomena under the same general head of "solubilities."

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* Extracted from the Preface to the "First Outlines of a Dictionary of the Solubilities of Chemical Substances."

† Dans les sciences naturelles, et surtout dans la chimie, les généralités doivent résulter de la connaissance minutieuse de chaque fait, et non la précéder.—Gay-Lussac, Premier Mémoire sur la Dissolubilité des Sels dans l'Eau.

Any extended discussion of the methods ordinarily employed in determining solubilities, and the precautions necessary to insure accuracy, would perhaps hardly be in place here. Directions for making such experiments may be found in several chemical handbooks—for example, in Fresenius's "System of Instruction in Quantitative Chemical Analysis," or, better, in the original memoirs of those chemists who have occupied themselves with the experimental determinations of solubilities, references to which may be found in the body of this work. It may, nevertheless, be well to remark here that the text-books do not usually lay sufficient stress upon the preparation of the solution of the substance under examination, and yet this is the single fundamental point of a correct determination, the other steps of the process being altogether subsidiary, and, in general, easy of execution, as well as comparatively free from sources of error. It is commonly stated that an exactly saturated solution of a salt may be prepared either by exposing a large excess of the salt to the action of the solvent during several hours at the desired temperature (method by digestion), or by heating a mixture of the salt and solvent until a strong solution has been obtained at a temperature higher than that at which the determination is to be made, and then cooling this solution to the desired degree, and maintaining it at this point for some time in contact with crystals of the salt, the whole being frequently agitated (method of cooling).

Now, the latter method, though theoretically correct, is, in practice, peculiarly liable to error, and great care should consequently be exercised in employing it. It is no doubt true that, as regards most substances, the saturated solutions prepared by either method would finally coincide in composition, provided the cooled solution be allowed to stand, under proper conditions, for a sufficient length of time. Yet it is often exceedingly difficult thus to obtain normally saturated solutions, even of our most common and easily crystallised salts, within the limits of time which can be conveniently allotted to a single experiment. This depends upon the tendency of the solutions of many, if not of most, substances to an indeterminate supersaturation when cooled from a higher to a lower temperature. This supersaturation is not always easily to be detected unless comparative solutions are prepared by the method of digestion, and the length of time required by any given solution to assume the normal condition is a point not readily ascertained. Gay-Lussac, in his classical memoir upon the solubility of salts in water,[‡] enjoins the necessity of maintaining the final temperature constant during at least two hours.[§] His own experiments were made in the cellar of the Observatory at Paris, in which the thermometer varies but a fraction of a degree centigrade in the course of the year; they are unquestionably correct in themselves, and there can be little doubt that his statement regarding the preparation of normally-saturated solutions by the method of cooling is true, not only for the limited number of salts upon which he operated, but in general for crystalline substances. Yet the rule seems hardly safe to be followed in all cases by experimenters less favourably circumstanced, and it is obviously inapplicable to numerous uncrystallisable substances, or those liable to pass into an amorphous gum-like condition, or to undergo other molecular changes. The difficulty of avoiding supersaturation is, moreover, illustrated by the experience of Legrand, who found that solutions might become supersaturated to a certain extent even while they were actually boiling.[‖]

Indeed, it is my opinion that, next to the impurity of the material operated upon, by which many published determinations have unquestionably been vitiated, there is no source of error so grave, none which has so seldom been fully guarded against, or so often altogether overlooked, as this tendency to supersaturation.

On the other hand, in the preparation of solutions by the method of digestion a difficulty is encountered in the tendency of many substances—like arsenious acid, for example—to dissolve with extreme slowness. This can, however, be overcome by the exercise of patience, and, in any event, admits of being detected and controlled. It would, therefore, appear that, where practicable, the method by digestion should generally be preferred, at least for temperatures low enough to insure the experiments against the influence of evaporation. The completion of the solution can then always be ascertained by determining from time to time the amount of substance dissolved, the operation being considered finished when the results of two of these tests accord with each other. As frequent agitation is indispensable, some process of stirring by machinery moved by clockwork, analogous to that described in Mohr's *Lehrbuch der Pharmaceutischen Technik*, might probably here be used with advantage.[¶] Kemp's regulator [**] for maintaining constant temperatures might also be found serviceable in some cases.

[‡] *Annales de Chimie et de Physique*, 1819 (2), 11, 298.

[§] "Dans chaque cas il faut maintenir constante la temperature finale pendant deux heures au moins, et remuer frequemment la dissolution saline, pour être bien assuré de sa parfaite saturation."

[‖] "Il semble d'abord que pour avoir cette température, il n'y a que observer celle à laquelle le sel *commence* à se déposer; mais on n'aurait ainsi rien de constant, il faut prendre celle qui a lieu *pendant* que le sel se dépose. En effet, j'ai remarqué que la dissolution pouvait se saturer malgré le mouvement d'ébullition, et atteindre une température de plus en plus élevée; mais aussi tôt que le sel se dépose, le thermomètre redescend en un point où il se tient parfaitement fixe."—*Ann. Ch. et Phys.* (2), 59, 428.

[¶] Compare Berzelius in his *Lehrbuch*, 3, 32, *et seq.*

[**] Liebig and Kopp's *Jahresbericht*, 3620, 10,612, 12,709; also *Journal of the Franklin Institute*, (3), 25,319.

Royal Institution.—The general monthly meeting will be held on Monday, July 4, at two o'clock.

PHYSICAL SCIENCE.

Suggestions for a Thermo-Spectrometer, by William Crookes, *F.R.S.*

When soda is brought into a flame and the emergent light examined in the spectroscope it is seen to be of one degree of refrangibility only. Over the whole range of the visible spectrum, from the lowest red to the extreme violet, only one narrow line vibrates in synchrony with the heated soda atoms. But Professor Megnus has lately shown that *heat* is likewise given off by the soda flame in very large quantities, and these heat rays are just as much a portion of the spectrum as the visible or the actinic rays. If, therefore, we had some means of observing the thermic spectrum we should find that the sodium spectrum was far from simple. Optically, sodium stands next to thallium in the simplicity of its spectrum; at ordinary flame temperatures, thallium radiates one, whilst sodium radiates two homogeneous rays; these latter so close together, as to appear but one in ordinary instruments. Other metals give more complicated visible spectra; the activity imparted to them by the high temperature is expended over a wide extent of the coloured spectrum, whilst with sodium and thallium, the energy is concentrated into one line; hence the wonderful luminosity of these homogeneous lights, and the excessive brilliancy which they exhibit in comparison with other coloured flames given by different metals. Sodium, however, spends some of its vibrative energy in the invisible heat spectrum, and it would be a matter of considerable interest to examine whether the other metals, such as lithium and thallium, which give simple optical spectra, also radiate heat rays. This has indeed been found to be the case with lithium, which is stated by Professor Magnus to act like sodium, and it is probable that thallium would act in a similar manner; but from these theoretical considerations we should not expect to find that metals which yielded complicated optical spectra, such as barium or copper, would also emit heat rays of great intensity. Physicists now require a thermo-spectroscope, or, rather, spectrometer—an instrument which will enable them to examine and map out the thermal lines of the spectrum, as accurately as this can be done with the visible and photographic portion. With light (or rather with heat radiations) of tolerable intensity, this would not be difficult to effect. A single row of antimony and tellurium bars, soldered together at their alternate ends, as in the ordinary antimony-bismuth thermo-electric pile, could be securely cemented to a solid plate of glass and ground perfectly flat. This flat side could then be cemented to a permanent support of glass, porcelain, ebonite, or other suitable non-conducting material, and the other side (after removal of the temporary glass support) should be likewise ground down, until the series of bars was no thicker than a card. This side should now be cemented on to the same kind of supporting material as was used for the other side, and the whole firmly and securely sealed up at the sides, so as to leave only the ends exposed. The end of this pile would now be in the form of a very narrow line, which might be half an inch or so in length, and would consist of the extremities of ten or a dozen couples of antimony and tellurium bars, each not larger than a pin. The extremities of this battery being connected with a very sensitive galvanometer; the pile, upon being carried along the ultra-red end of the spectrum, would instantly reveal when a ray of heat shone upon it, by a deflection of the needle; and the comparative intensities of the thermic rays could be, at the same time, ascertained from the angular distance to which the needle was driven. In this manner heat spectra could be mapped out with considerable accuracy.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 16, 1864.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

The minutes of the preceding meeting having been read and confirmed and the several donations to the Society's library announced, Charles Tomlinson, Esq., Lecturer on Science in King's College, London, was formally admitted a Fellow of the Society, and the undermentioned gentlemen were duly elected by ballot—viz., G. W. Knox, B. Sc., Bristol; Michael Carpael, New Bond Street; Sidney Pontifex, Leadenhall Street.

A paper, by C. Schorlemmer, Esq., "*On the Identity of Methyl and Hydride of Ethyl,*" was read by the Secretary. The author commenced by referring to an experiment in which equal volumes of chlorine and the gaseous hydride of ethyl were exposed to diffused daylight, and the chlorine substitution products thus obtained were collected and purified in the manner fully described in a communication to the Royal Society, entitled "*On the Action of Chlorine upon Methyl.*" A colourless mobile liquid, condensed in the receiver, which consisted chiefly of chloride of ethyl, C_2H_5Cl, boiling at 11° C. Besides this compound, a small quantity of a liquid having a higher boiling-point was formed, from which monochlorinated chloride of ethyl, $C_2H_4Cl_2$, could be isolated. The results of these experiments differed widely from those of older researches of Frankland and Kolbe, who studied the action of chlorine upon the gas obtained by treating cyanide of ethyl with potassium, which they first considered as methyl, but afterwards recognised as hydride of ethyl. By the action of one volume of chlorine upon one volume of hydride of ethyl, they obtained one volume of hydrochloric acid and one volume of a gas having the composition C_2H_4Cl, which substance was believed not to be chloride of ethyl because it could not be condensed at −18° C. Frankland showed afterwards that by the action of two volumes of chlorine upon one volume of hydride of ethyl, a liquid substitution product was formed, but that by acting with one or two volumes of chlorine upon one volume of methyl only, gaseous chlorine compounds were formed. Frankland and Kolbe performed their experiments with perfectly dry gases, whereas the author employed them in the moist state. It therefore became necessary to repeat the experiments of Frankland and Kolbe exactly under the circumstances described by them, only on a larger scale; but the author obtained results coinciding with those already described as having been furnished by the moist gases. One volume of chlorine and one of methyl, or one volume of hydride of ethyl, in the dry or moist state, yielded one volume of hydrochloric acid and chloride of ethyl, which always contained a small quantity of its chlorine substitution products. From these experiments it would appear that there does not exist any chemical difference between methyl and hydride of ethyl, and that the lowest isomeric terms of the two series of radicals and hydrides stand in the same relation as the higher terms do. With regard to differences in their physical properties, the author considered that, like all isomeric hydrocarbons of these groups, they exhibit a close agreement, and only in their degrees of solubility in water was a slight disagreement noticed. The values of the coefficients of absorption of methyl are a little smaller than those of hydride of ethyl, but the curves representing these coefficients are nearly parallel, and very close to each other. Schickendanz, who determined the solubility of hydride of ethyl in water, thinks that it would appear probable that this relation between the coefficients of absorption of the two gases was not accidental, but might be attributable to their chemical constitution as isomeric bodies. The author believes that the slight difference in the solubility and the parallelism of the two curves may easily be accounted for by the existence of impurities in the methyl employed by Bunsen, which was prepared by the action of zinc upon iodide of methyl, a method which yields the least pure product, and even a small admixture of a foreign gas cannot fail to exercise a considerable influence on the value of the coefficients. In alcohol the two gases are also soluble in the same proportions, and hence the author believes himself justified in asserting "that until differences are found between methyl and hydride of ethyl better marked than those above mentioned, we must consider the hydrocarbons, C_2H_6, derived from different sources, as identical, and as being hydride of ethyl or dentyl."

The President considered the author's communication to have an important bearing upon the theory of radicals. The results so far were mainly of a negative character. One proof of identity had been brought forward; but otherwise there did not appear to be any difference between the chemical properties of methyl and those of the hydride of ethyl.

Dr. Frankland did not allow the author's experiments to be conclusive, especially those relating to the production of the normal chloride of ethyl in the presence of water. Dr. Kolbe and himself had investigated the action of potassium upon the cyanide of ethyl, and the results were exactly in accordance with the published statements just now called in question by Mr. Schorlemmer. Further researches were required before the identity or isomerism of these bodies could be determined. For himself, he believed they were not identical, but only isomeric.

Mr. C. H. Greville Williams said that this class of investigations was attended with the greatest possible difficulty; and it behoved us to suspend our judgments. Amongst the products of the destructive distillation of Boghead coal were several substances having the same composition and boiling point (excepting butyl), and giving similar nitro-compounds with fuming nitric acid. Recent investigations of the tertiary monamines of the picoline series had led him to the conclusion that the lutidine derived from the destructive distillation of quinine is not the same as the lutidine of Boghead naphtha.

Professor Wanklyn would have been glad to know whether the chlorine substitution product obtained by Mr. Schorlemmer was the veritable chloride of ethyl. It might have been but an isomer. Ethyl boils at 20° C., whilst hydride of butyl, which is absolutely identical with it in composition, boils at about zero; thus showing a considerable difference of 20°. In a similar manner the hydride of hexyl obtained from mannite is only isomeric, but not identical, with that prepared from Boghead coal. An interesting fact had recently been made known by Carius, to which reference should have been made in the author's paper—viz., that, by acting upon ethyl with bromine, the bibromide of butylene was produced. Again, to Cahours and Pelouse was due the generality of the method of investigation followed by Mr. Schorlemmer; and he considered that this circumstance should have been acknowledged by the author.

Dr. Odling thought great praise was due to Mr. Schorlemmer for having upset the only point which has hitherto been relied upon as establishing a difference between methyl and the hydride of ethyl. The difference in their coefficients of absorption was really so slight as to be easily accounted for by variations in the degree of purity of the substances. The author had a full right to adopt an opinion contrary to that of Dr. Frankland, and to consider these bodies identical, not merely isomeric. With reference to Professor Wanklyn's remark, he felt it impossible to acknowledge continually the prior labours or steps in an investigation already ascertained by other experimentalists. It was not necessary at the present time, and positively inconvenient, to have always to mention Bechamp's name in connexion with the admirable process of reduction with acetic acid and iron filings, which chemists had already given him the credit of having originated.

Sir Benjamin Brodie having inquired whether any difference in constitution was supposed to exist, which would account for the discrepancies regarding the chlorine substitution products?

Dr. Frankland wrote upon the board the formulæ undermentioned, and he believed it possible that in one example the chlorine replaced an atom of hydrogen forming part of the radical, and in the other instance attacked only one of the outstanding atoms of hydrogen, thus:—

Methyl product. Chloride of ethyl.

$$C\left\{\begin{array}{l} CH_2Cl \\ H \\ H \\ H \end{array}\right. \qquad C\left\{\begin{array}{l} CH_3 \\ H \\ H \\ Cl \end{array}\right.$$

Professor Wanklyn suggested there might then be twenty-four possible combinations.

The President then called upon the Secretary to read a paper "*On the Action of Baryta on Suberic Acid*," by Mr. Richard Dale, of Owen's College, Manchester. The author commenced by referring to the hydrocarbons C_6H_{14} and C_8H_{18}, boiling at 76° and 125° C respectively, and stated that his experiments had for their object the isolation of an intermediate number of this group. By the action of nitric acid on castor oil, suberic acid $C_8H_{14}O_4$, and azelaic acid, $C_9H_{16}O_4$, were conjointly produced. The white powder resulting from this action was treated with ether, in which the latter was more soluble. The suberic acid was obtained in needle-shaped crystals, and the azelaic acid in pearly white scales. From two and a-half kilogrammes of castor oil 90 grammes of suberic acid and 75 of azelaic acid were obtained. The acids and silver salts were analysed, and when azelaic acid was distilled with baryta, the hydride of heptyl, boiling at 99° C., (Schorlemmer) was obtained.

The remainder of the evening was devoted to the description of "*Vacuum Experiments*," by Dr. Hermann Sprengel, which will be given in our next. The meeting was then adjourned until the 30th June.

LECTURES ON CHEMICAL PHILOSOPHY.

Delivered at the College of France, by M. A. Wurtz.

[The course of lectures recently delivered by M. Wurtz has been devoted to the exposition of modern theories in chemistry, and we have thought that their reproduction here in abstract would be of interest to our readers who seek for a lucid explanation of recent ideas.]

In the present course of lectures I propose to expound the chemical theories which have of late years directed the investigations of many experimenters, and which are now beginning to prevail. I shall endeavour to do this with the modesty belonging to a *savant*, and with the respect which is due to the opinions of others. I know that our theories are subject to variation, growing with the progress of knowledge, and sometimes only the expression of a momentary want. But I know, also, that theory is the soul of science, the torch of experiment, and that from it has proceeded what we call the new chemistry.

Strictly speaking, there is no new chemistry. In the development of chemical ideas there have been no sudden changes, no violent subversions, in a word, no revolutions. Chemistry, since Lavoisier, has been in a state of continued steady progress. But things have not essentially changed; the chemistry of to-day is only a continuation of the chemistry of the beginning of the century. All the modifications accomplished since Lavoisier have been produced by rational experiment, the influence of which is necessarily permanent. To enlighten ourselves on this point let us endeavour to follow the progress of the theory of the science from Lavoisier's time to our own.

Positive chemistry arose from an attentive study of the phenomena of combustion and the constitution of salts. It was observed that the calcination of a metal was nothing less than the combination of the metal with oxygen, the formation of an oxide, in fact. It was seen, also, that acids result in general from the addition of oxygen to another substance. At last it was proved that salts were easily formed by the union of an acid and an oxide. Other observations confirmatory of the preceding were made, and in time it was said that all salts were binary—that is to say, compounds of an acid and a base; or to express it more generally—that every compound system could be divided into two more simple antagonistic systems. That was the foundation of the edifice raised by Lavoisier. That was the base of *dualism*.

The labours of those who immediately followed the founders of chemical science, the discoveries of the composition of the alkalies and the elementary nature of chlorine; the discovery, also, of the composition of cyanogen, which, notwithstanding its complex nature, formed binary compounds exactly like the binary compounds of chlorine, &c.—all these facts appeared a striking confirmation of the ideas of Lavoisier.

Berzelius, by discovering the double chlorides and double sulphides, which he named chloro-salts and sulpho-salts, contributed to strengthen these ideas. He did more than this; he attempted a theoretical explanation of dualism, and published an hypothesis which has had a great success—the electro-chemical theory.

We know that bodies combine in definite proportions, and sometimes in multiples of those proportions. We know, also, that Dalton, to explain this general law, supposed the existence in every simple body of small indivisible masses or atoms, each having a particular weight—the atomic weight; and that compound bodies are formed of these atoms placed in juxtaposition. Berzelius seized on the idea of the atoms, and supposed each to have two poles in an opposite electrical state. In some atoms positive electricity predominates, in others it is the negative. Bring two atoms in opposite electrical states together, and they attract each other and unite. Suppose three or four of them, they will always constitute two antagonistic groups, so that the resulting compounds will be constantly binary. Such was the theory of Berzelius. The only proof of the truth of this theory Berzelius required was the action of a current upon chemical compounds. Chloride of potassium, for example, decomposed by the current into two simple bodies, chlorine and potassium; sulphate of potash is also decomposed into potash and sulphuric acid, the metallic group going to one pole and the non-metallic to the other.

$$KCl = K + Cl$$
$$KOSO_3 = KO + SO_3$$

Here, then, was the verification of the hypothesis! No: for, as we shall show further, the experiments on which the illustrious Swedish chemist relied must be turned against him. The interpretation which he gave of them was not exact.

Dualism, however, being in the estimation of Berzelius the general expression of truth, he set about applying it to the whole science. Lavoisier had already spoken of *compound radicals* which could unite with oxygen to form acids; that is to say, he had considered these acids as *couples*. Berzelius went a step further, and believed that it must be so with all bodies. Thus, according to him, acetic anhydride, $C_4H_6O_3$, is formed of the radical acetyle, C_4H_6 and O_3. Ordinary acetic acid he supposes a compound of acetic anhydride, $C_4H_6O_3$, and water, H_2O; that is, an hydrate, a salt, composed of acid and base. Sulphuric anhydride again, SO_3, combines with water, H_2O, to form sulphuric acid, SO_3H_2O,—a binary compound, an hydrate, in fact.

Endowed with a grand imagination, Berzelius succeeded in bringing all the great discoveries in chemistry up to 1830 into agreement with his ideas. Thus when Chevreul published his remarkable investigations on fatty bodies, and showed that fats are neutral bodies composed of glycerine and a fatty acid, Berzelius contended that glycerine was an oxide of lipyl. In the same way he explained the discoveries of Dumas and Boullay on the compound ethers. These, said he, are compounds of an acid with oxide of ethyl, $C_4H_{10}O$. Acetic ether, for example, contains $C_4H_6O_3 + C_4H_{10}O$, just as sulphate of potash is $SO_3 + KO$. The remarkable results obtained by Liebig and Wöhler with the benzoilic compounds were explained in a similar way. Thus, we see that up to 1830 chemists in general sought to apply to organic bodies the current ideas on mineral chemistry.

But now from 1834 a change begins. A great discovery has been made. Dumas and Laurent have found that chlorine, an electro-negative body, may be substituted for hydrogen, an electro-positive body; that is to say, chlorine may be combined otherwise than by molecular addition—in other words, by substitution. Chlorine may be substituted for hydrogen, equivalent for equivalent. This was afterwards confirmed, and the researches were extended by Laurent, Gerhardt, Malaguti; but the first announcement by Dumas of the discovery and its consequences was sufficiently precise to disconcert any other chemist but Berzelius. He not only refused to modify his theory, he even pretended that dualism was not affected, and laughed at the theory of substitutions.

Let us see how he disposed the notation of some organic compounds. Formic acid, for example, $C_2H_4O_4$, is formed of a radical, C_2H_2O, and water, H_2O; it is a binary compound, a couple. Chloroform, which, according to Dumas, is only the result of the substitution of 3 Cl for 3 H in C_2H_4, and which may therefore be represented as $C_2(HCl_3)$, chloroform is according to the dualist a compound of the radical C_2H_2 and 3 Cl. Trichloracetic acid is also represented in the system by the binary symbol

$$[C_2H_3 + C_2Cl_3] + H_2O.$$

Such is the dualistic system of Berzelius, and every one will admit that supposing the experimental starting point to be correct, such deductions must always have been rash and hypothetical. But, as we shall proceed to show, the starting point was not correct.

There was, then, an urgent need of a chemical theory at once more comprehensive, more positive, and more rational than that of Berzelius. We shall see it born, and slowly develope itself.

Dumas, taking experiment and rigorous induction as his sole supports, was led to represent acetic acid as $C_4H_8O_4$, and trichloracetic acid as $C_4(H_2Cl_6)O_4$. Having observed, in fact, that the chemical properties of the chlorinated acid are completely analogous to those of the ordinary acid, and that the quantity of hydrogen which disappeared was exactly equivalent to the quantity of chlorine substituted, he naturally concluded that if $C_4H_8O_4$ is the experimental expression, so to speak, of the normal acid, $C_4(H_2Cl_6)O_4$ is that of the chlorinated acid. In other words, said he, trichloracetic acid *belongs to the same type* as acetic acid. This was the origin of the theory of types.

Dumas at first believed in two kinds of types; the *chemical* type of which he was himself the author; and the *mechanical* type, the first idea of which was started by Regnault. Compounds belonging to the chemical type are those which contain the same number of atoms similarly united, and whose fundamental chemical properties are identical. Compounds belonging to the mechanical type are those which while containing the same number of atoms present dissimilarities in the chemical characters of their products of metamorphosis. We mention the latter only for the sake of historical accuracy In what follows we shall speak only of chemical types.

At first the theory of types was only applied to the hydrogenated compounds of carbon, and their oxygen, chlorine, and bromine, &c., derivatives by substitution. There was a great number of types, and they only included a small number of compounds. But thanks to the researches of Laurent, Williamson, and especially of Gerhardt, the theory of types was at once simplified, and, moreover, received an indefinite extension. It was Laurent who first showed that oxides are exactly analogous to hydrates; that the one and the other only differ from water by the substitution of one or two atoms of metal for one or two atoms of hydrogen:; that, for example, if we represent water as H_2O, caustic potash is $(KH)O$, and oxide of silver Ag_2O. Thus he inferred that water is the type of oxides

Then came the experiments of Williamson on etherification, which showed that hydrate of ethyla was nothing more than water,

$$H_2O, \text{ or, } \left.\begin{matrix}H\\H\end{matrix}\right\} O,$$

in which one atom of hydrogen H is replaced by the group C_2H_5

$$\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\} O;$$

and that ether is water in which both atoms of H is replaced by the group C_2H_5

$$\left.\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right\} O.$$

Gerhardt seized on these results and on others at which he had arrived in the study of the ammonia compounds and the anhydrides, brought together and compared all these ideas and facts, and by his powerful mind for generalisation produced a theory of types entirely novel. His theory consisted in the choice of four simple types—hydrogen, water, hydrochloric acid, and ammonia—in relation to which we may place, or from which we may derive, by substitution, all the other compounds of mineral and organic chemistry.

We have already shown how the water type and its derivatives are expressed. Let us now consider the hydrogen type. Hydrogen is figured as

$$\left.\begin{matrix}H\\H\end{matrix}\right\}.$$

The bodies belonging to the same type, if simple, are similarly expressed

$$\left.\begin{matrix}K\\K\end{matrix}\right\}, \text{or, } \left.\begin{matrix}Cl\\Cl\end{matrix}\right\}.$$

If we effect substitutions we have

$$\left.\begin{matrix}K\\Cl\end{matrix}\right\}, \text{ or, } \left.\begin{matrix}H\\Cl\end{matrix}\right\},$$

bodies belonging to the same type.

The ammonia type is represented as

$$\left.\begin{matrix}H\\H\\H\end{matrix}\right\} N,$$

a formula in which we may substitute for a variable quantity of H, a variable quantity of any other simple radical or group. Thus, by substituting one of K for one of H we have

$$\left.\begin{matrix}K\\H\\H\end{matrix}\right\} N,$$

or potassium amide, and if we replace one of H by C_2H_3O, we shall have

$$\left.\begin{matrix}C_2H_3O\\H\\H\end{matrix}\right\} N,$$

or acetamide.

This is the foundation of the theory of types of which Gerhardt is the author. It bears the stamp of his genius, and is at once simple and fruitful, Since his time, and by the hands of other chemists, discoveries have succeeded discoveries with a rapidity until now unknown in the history of sciences; organic chemistry has received an unimagined extension, and that gift of foreseeing which is the characteristic of rational progress has been greatly developed.

(To be continued.)

ACADEMY OF SCIENCES.

June 20.

The proceedings of the last meeting of the Academy offer but little of interest to chemists.

Dr. Hofmann contributed a paper, entitled "*Facts Relating to the History of the Colouring Matters Derived from Coal-Tar.*" In this paper he describes an oil obtained by the dry distillation of aniline blue. The author is disposed to regard the product as diphenylamine. With nitric acid, and apparently all oxidising agents, diphenylamine yields a magnificent blue colour. Some other reactions of this body are curious, and we shall return to them.

A fact of great importance was mentioned in a memoir by M. Langier. The author sewed together the divided ends of a median nerve, and found that they perfectly united. Sensation and power of motion were re-established in the limb in the course of some days, and to a certain extent in a few hours.

NOTICES OF BOOKS.

A Companion to the British Pharmacopœia; comparing the Strength of the Various Preparations with those of the London, Edinburgh, and Dublin, United States, and other Foreign Pharmacopœias; with Practical Hints on Prescribing. By Peter Squire, F.L.S., &c., &c. London: Churchill and Sons. 1864.

Mr. Squire is already favourably known to the Medical and Pharmaceutical world as the author of two very useful compilations. The present work will greatly increase his reputation. *Par excellence* it is *the* work on the British Pharmacopœia.

We shall give our readers the best idea of the contents and method of the book by making a short extract:—

"Digitalis.

"The dried leaf of the *Digitalis purpurea*, gathered when about two-thirds of the flowers are expanded.

"*Medicinal Properties.*

"Sedative and diuretic. Much used in various cardiac affections. It is cumulative in action, and requires much caution. Externally a strong infusion may be applied for dropsy.

"*Preparations.*

"Infusum.—Digitalis, dried, 30 grains; boiling distilled water, 10 grains; infuse one hour and strain.

"(Same strength as Lond.; half that of Edin. and Dub.) Dose, ½ to 1 oz.

"Tinctura.—Digitalis, dried and bruised, 1; proof spirit, 8; macerate forty-eight hours with 6 of spirit, agitating occasionally; pack in a percolater and let it drain, then pour on the remaining spirit; when it ceases to drop, press and wash the marc to make up 8.

"(Same as Dub.; Lond. and Edin., 1 to 10; Fr. 1 to 5; Belg., 1 to 6; Pr., 1 to 7; Austr., 1 to 8.)

"Dose—as a diuretic, 20 to 30 minims."

The above extract requires a little explanation. It will be seen that Mr. Squire expresses some of the formulæ in parts. So long as these are taken as ounces no doubt will be felt, since the author gives at the top of each page the general direction "solids by weight, liquids by measure." But if pounds are thought of, it must be remembered that by a liquid pound the author means sixteen fluid ounces.

Aiming also at great conciseness, the author will at times puzzle a simple-minded reader, as at page 14, where he describes Etheris nitrosi spiritus as "distilled from nitrite of soda." It would have been better in such a case to have given the whole directions. There is, however, a note to this preparation which we give as a sample of the remarks which will be found scattered about the book.

"This preparation will always be of uncertain strength, in consequence of the variable composition of the nitrite of soda made according to the Pharmacopœia. This substance is a mixture of nitrate, nitrite, carbonate, and caustic soda, and will in no case fulfil the conditions laid down in the Pharmacopœia test. The proportion of nitrite will vary from 5 to 25 per cent. (never more), and the strength of the spirit of nitrous ether will be influenced accordingly."

There are also some remarks on the Liquor ferri perchloridi which we are tempted to extract:—

"Liquor ferri perchloridi made by the process of the Pharmacopœia has a sp. gr. 1·395, is almost black, and contains both protochloride of iron and free nitric acid. When mixed with three times its volume of rectified spirit, as directed for making the tincture, a considerable deposit is soon produced. If the evaporation is pushed to 6 ounces instead of 10 as directed, complete oxidation takes place, but a large quantity of basic chloride is thrown down, because there is not sufficient hydrochloric acid to keep it in solution, and the nitric acid is not got rid of. This, by gradually acting upon the alcohol, producing ether, will cause the tincture to become turbid.

"In order to have a successful result, the quantity of hydrochloric acid must be augmented to 13 ounces, and the solution should be evaporated to 5 ounces. The addition of 5 ounces of water will then bring up the bulk to 10 ounces, as required by the Pharmacopœia, and the sp. gr. will be 1·400. The tincture made with this solution will remain bright, and have the sp. gr. 0·992."

Mr. Squire was a member of the Pharmacopœia Committee, and we must express our regret that he has had to make such remarks as the foregoing in his book.

There is one useful feature in the work to which we shall call attention by another extract. The author, as often as necessary, after the officinal preparations of a medicine, gives a list of non-officinal remedies. Here is one:—"Tinctura chloroformi composita.—Chloroform, 4 oz.; rectified spirit, 4 oz.; treacle, 4 oz.; extract of liquorice, 2½ oz.; muriate of morphia, 8 grains; oil of peppermint, 16 minims; syrup, 17½ oz.; prussic acid (2 per cent.), 2 oz."

This, the author states, has been represented to him as the composition of chlorodyne, but we cannot suppose he believes the representation correct. There will be less than a quarter of a grain of muriate of morphia in an ounce of the above preparation, and Mr. Squire gives the maximum dose at 10 minims.

We have no wish, however, to be hypercritical on a work which contains so much to be commended; and shall now only repeat our already expressed opinion that this is the best work which has yet appeared on the British Pharmacopœia.

Annales de Chimie et de Physique. May, 1864.

The greater part of this journal is filled with a paper by M. Baudrimont "*On the Chlorides and Bromides of Phosphorus.*" The novelties in the paper are thus summed up:

1. Phosphoric chloride (PCl_5) attacks most elements, and especially the metals, sometimes forming double chlorides, more often forming a metallic chloride and phosphorous chloride (PCl_3).

2. Phosphoric chloride also attacks sulphides, and forms metallic sulpho-phosphides.

3. Sulphophosphide of mercury has a definite composition:—$PS_3,3(HgS)$.

4. Chlorosulphide of phosphorus can be obtained by the action of PCl_3 on SbS_3.

5. Many chlorides may combine with PCl_5 to form well-defined compounds.

6. Among these is a compound of bichloride of platinum with PCl_5 obtained by sublimation.

7. Phosphoric bromide, PBr_5, *dissociates* easily. In the presence of carbonic acid it splits up completely into PBr_3 and free bromine.

8 and 9. A bromoxide of phosphorus, PBr_3O_2, and a bromosulphide of phosphorus, PBr_3S_2, exist.

The author concludes his paper with a caution to experimenters on the disastrous effects of breathing the vapours of the chlorides of phosphorus and their derivatives.

An interesting memoir by M. Barbier follows, "*On the Application of the Phenomena of Capillarity to the Construction of Various Thermometers,*" which is much too long for us to transcribe, and which would hardly be intelligible without the accompanying plates.

A translation of Mr. Graham's paper "*On the Molecular Mobility of Gases*" concludes the number, showing that its importance and value are thoroughly appreciated by our neighbours. It is the third translation into French we have noticed.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1320. James Haswell Burke, London, "Improvements in lamps, vessels, tubes, and cocks, especially useful for preventing the transmission of flame or explosive action when using petroleum, camphine, or other inflammable or explosive substances."—Petition recorded May 27, 1864.

1335. Thomas Drew, the elder, Derby Villa, Tranmere Park, Birkenhead, "Improvements in the manufacture of paper, papier mache, and millboard."

1342. William Edward Newton, Chancery Lane, Middlesex, "Improvements in the treatment of the low or poor products obtained in the manufacture or refining of sugar."—A communication from Eugene Bartholomey, Rue St. Sebastien, Paris, France.—Petitions recorded May 30, 1864.

1346. George Davies, Serle Street, Lincoln's Inn, Middlesex, "Improvements in artificial teeth, and in moulds for forming the same."—A communication from John Terrel and Joseph Stulb, Philadelphia, Pennsylvania, U.S.—Petition recorded May 31, 1864.

1286.—Richard Archibald Brooman, Fleet Street, London, "Improvements in apparatus for increasing the illuminating power of gas, and for producing gas by the vaporisation of hydrocarbons and essences of petroleum."—A communication from Gustave Bouchery and Jules François le Batteux, Paris, France.—Petition recorded May 21, 1864.

1336.—James Paterson, Greenock, N.B., "Certain improvements in the cooling and preparation of charcoal to be used for refining sugar, and in the machinery, apparatus, or means employed therefor."—Petition recorded May 30, 1864.

1366.—Oscar Eugen Prieger, Bonn, Prussie, "The manufacture of ferromanganese and cupromanganese, and the combinations or alloys thereof with other metals."

1368.—William Cormack, Little Moorfields, London, "Improvements in the distillation or destructive distillation of all solid matters or semi-solid matters capable of yielding fluids, or gaseous hydrocarbons, or other products of any kind whatsoever, be they liquids, fluids, or solids, such as pit-coal, boghead, or other bituminous coal or shale, peat, wood, asphaltes, tallow, lard, fats, or other semi-solid matters, and in the treatment of the same."

1370.—William Henry Mellor, Liverpool, Lancashire, "Improvements in self-acting, mashing, or saturating apparatus for the use of brewers, distillers, and others."—Petitions recorded June 2, 1864.

1386.—William Clark, Chancery Lane, Middlesex, "Improvements in electro-magnetic and magneto-electric apparatus, and their application as a stationary or locomotive driving power."—A communication from Jean Henry Cazal, Boulevart St. Martin, Paris.

1387.—Bondy Azulay, Rotherhithe, Surrey, "Improvements in treating petroleum and its products, and in the application of apparatus for that purpose."—Petitions recorded June 3, 1864.

1401.—James Napier, Glasgow, Lanarkshire, "Improvements in separating certain metals and metallic substances from ores and other matters."

1406.—Edward Loysel, Manor House, Clapham, Surrey, "Improved apparatus for obtaining extracts from tea, coffee, and other vegetable substances."

1408. William Clark, Chancery Lane, Middlesex, "Improvements in the preparation of phosphates of ammonia and ammoniaco-magnesian phosphates."—A communication from Emmanuel Adrien Lesieur, Boulevart St. Martin, Paris.—Petitions recorded June 6, 1864.

1412. Henri Adrien Bonneville, Rue du Mont Thabor, Paris, France, "Improvements in telegraphic printing apparatus."—A communication from Victor Delaye, Rue de la Paix, Paris, France.

1418. Arthur Thomas Weld, Gravesend, Kent, and John Folliott Powell, Albion Place, Hyde Park, Middlesex, "Improvements in the separation of animal substances from rags of mixed fabrics."—Petitions recorded June 7, 1864.

1425. Thomas Richards, Wincanton, Somersetshire, "Improvements in liquid manure and water carts."

1426. Ferdinand Henry Warlich, Maze Hill, Greenwich, Kent, "Improvements in the manufacture of artificial block fuel and coke, and in apparatus employed therein."—Petitions recorded June 8, 1864.

1438. Napoleon Sarony, Birmingham, Warwickshire, "Improvements in the production and treatment of photographic portraits or pictures."—Petition recorded June 9, 1864.

1447. Charles William Siemens, Great George Street, Westminster, "Improvements in apparatus for producing combustible gases, part of which improvements are applicable for indicating the pressure of gases and fluids generally."—Petition recorded June 10, 1864.

1452. Peter Spence and John Berger Spence, Newton Heath, Lancashire, "Improvements in calcining and smelting copper ores."—Petition recorded June 11, 1864.

1456. William Sharp, Burgley, Yorkshire, "Improved means or apparatus for purifying and increasing the illuminating power of gas."

1458. John McElroy, Stretford, Lancashire, "Improvements in electro-telegraphic apparatus and in instruments for preparing the transmission of electric telegrams."—Petitions recorded June 14, 1864.

1486. Robert Whiteside, North Egremont, Cheshire, "Improvements in preserving iron ships and ships' sheathing from corrosion and fouling, and in apparatus to be employed therefor."—Petition recorded June 15, 1864.

Notices to Proceed.

338. William Culley Stobart, Etharley, Durham, "Improvements in coke ovens."—Petition recorded February 9, 1864.

355. Thomas Vincent Lee, Macclesfield, Cheshire, "Improvements in the construction of kilns or retorts for coking, and for apparatus connected therewith for collecting the products of distillation through the agency of hydro-caloric or superheated steam, these appliances being applicable to making wood, charcoal, and collecting pyroligneous acid during the process."

357. Jean Marius Faget, Bordeaux, France, "Improved apparatus for taking up the emanations and the gases from boilers."

360. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of superphosphates to be employed in the making of bread and in other purposes in the arts."—A communication from Anthony Polluk, Washington, U.S.—Petitions recorded February 11, 1864.

432. Frederick John Arnold, Adam's Court, Old Broad Street, London, "Improvements in apparatus for producing and burning combustible gases for heating and lighting purposes."—A communication from Thomas Arnold, New York, U.S.—Petition recorded February 19, 1864.

472. Jean Francois Rivier, Boulevart de Strasbourg, Paris, France, "An improved system for filtering and purifying liquids with an endless spouting capillary filter."—Petition recorded February 25, 1864.

634. John Platt and William Richardson, Oldham, Lancashire, "Improvements in machinery or apparatus for breaking up or pulverising clay for the manufacture of bricks or other such articles, or for breaking up or pulverising other material."

635. Raymond Fletcher, Siddall's Road, Derby, "A new compound used for varnishing paperhangings and other articles."—Petitions recorded March 12, 1864.

674. Richard Archibald Brooman, Fleet Street, London, "Improvements in treating vegetable textile matters, in separating filamentous matters therefrom, and the application of such matters to spinning, weaving, and dyeing."—A communication from E. M. F. Bonneau, A. Dumont, and N. J. C. Canoby, Paris, France.—Petition recorded March 16, 1864.

CORRESPONDENCE.

Continental Science.

Paris, June 28, 1864.

As your readers, in common with all the other inhabitants of Great Britain, take the greatest possible interest in the weather, I cannot do better than begin my letter with that topic. For the last fortnight the temperature has been at fever heat, and the consumption of ices has been correspondingly high. On Sunday, however, to the delight of everybody, even of the holiday makers, the rain came down in torrents, and agreeably cooled the air. It is, perhaps, as well for you that the heat has moderated, for when the thermometer rises to such a pitch as it did last week, and stops there so long, there is an irresistible temptation to explore the woods round Vincennes (which, by the way, are almost denuded of their foliage by caterpillars) in search of botanical specimens, which somehow always die before one gets home, or ransack the quarries of St. Denis for fossils, which are always left behind, instead of attending hot lectures or writing letters with the perspiration bedewing the paper.

The subject of the sun leads one directly to photography. At the last meeting of the Photographic Society the Abbé Laborde read a paper on the "Reproduction of Kaleidoscopic Figures." I have always imagined that the great beauty of these figures resided in their colour, and to what end, therefore, should they be photographed? M. Laborde says these photographs would be useful to designers, but I fancy no decorative artist would be worth much who would seek the aid of the kaleidoscope for his patterns. M. Van Monckhoven read a paper on a new enlarging camera, which he has just perfected. The specimens exhibited are certainly the best enlargements yet seen, and by using a large lens of 19 inches in diameter for collecting the rays, an excellent positive may be taken on common albumenised paper in from twelve to fifteen minutes.

The Abbé Moigno, the esteemed editor of *Les Mondes*, has commenced giving monthly lectures to the subscribers to that journal, detailing the progress made in the different branches of science during the past month. The first meeting, which was held on the 9th of June, was so great a success that the room in which it took place proved too small, and the Abbé was obliged to petition the *Société d'Encouragement* for the use of their large hall in the Rue Bonaparte for the July meeting. Several new scientific inventions were shown. One of the most interesting was the stethoscope exhibited by Kœnig, which consists of a sort of box containing an artificial tympanum of india-rubber. The apparatus is laid on the chest of the patient, and the sounds of the heart and lungs are listened to through five or six india-rubber tubes provided with ear-pieces. Thus, in the case of hospital demonstration, the patient is freed from the inconvenience of having half-a-dozen hard stethoscopes pushed into his chest, and the students around hear the sounds produced at their ease.

Rumkorff has deservedly been presented with the Napoleon III. prize of 50,000 francs for the induction apparatus that bears his name. The King of Hanover has also sent him a large gold medal.

The Museum of Natural History has received several specimens of the meteorite that passed over this country on May 14. Had this happened in England, the specimens would have been visible to the public only about ten years afterwards.

The sericiculturists, having tried almost every possible remedy for the numerous ills that silkworm flesh is heir to, have now taken to electrifying their interesting patients, with, it is said, excellent effect. The idea has originated with M. Sauvageon, and has been tried at Valence.

The Association for the Advancement of Astronomy and Meteorology, founded by M. Lavoisier, is making great way. At the last meeting, held at the *Observatoire*, a new reflecting telescope with a speculum 0·80 metres in diameter was shown, and the process of silvering explained. The foundation of such societies will do much to render science really popular in Paris. The popular ignorance of scientific subjects amongst even highly educated Parisians is most singular. It is true they have no Royal Institution, or even Polytechnic, such as we have, but science of a very high kind enters into the educational courses carried on in French schools to a much greater extent than in ours.

Amongst the papers recently read before the *Société Stanislas*, at Nancy, was one by MM. Giles and Durant, on the utilisation of the rags of mixed fabrics, that is, of rags whose woof is cotton and the weft woollen, or *vice versâ*. It will be remembered that the general system pursued in England is to rot out the cotton by a weak acid or alkali, which leaves the wool intact. In such cases the cotton was lost, and a few years since Mr. F. O. Ward took out a patent for carbonising the wool by means of super-heated steam, which converted it into a valuable manure, leaving the cotton for paper-making. MM. Giles and Durant affect this by dissolving out the wool with the solution of an alkaline sulphide, the dissolved wool being available for the manufacture of prussiates. The authors of the paper were rewarded with the "Prix Ronfils." Amongst the other papers was one on a new green pigment of great beauty, which consists of manganate of barium.

The proceedings of the Atlantic Telegraph Company are looked upon over here with great interest. They will have a formidable rival in the Russo-American line, which, with the exception of about forty miles, will be a land line. Mr. Collins, an American, has lately obtained from the British and Russian Governments the right of passage through their territories for thirty-six years. Europe is already in momentary communication with Irkutzk, in Siberia. A line will consequently be laid from Irkutzk to the month of the Amour, thence along the coast of Asiatic Russia to over Behring's Straits, which is only about forty miles across, and so on through British North America and British Columbia to California, where the American network will be joined. An American Company has already been formed to supply the capital necessary for carrying out the work.

M. Sauerwein has lately analysed one of the thousand-and-one anti-incrustation boiler compositions — impositions if you like to call them so—which are sold to ignorant manufacturers at fancy prices. It consists mainly of chloride of barium mixed with 15 per cent. of bone-black, possibly that which remains after the manufacture of sugar. It acts by precipitating sulphate of barium in an insoluble form. Considering the cheapness and efficacy of soda-ash for the purpose, it seems singular that manufacturers should run after so many quack compositions of all the colours of the rainbow.

Messrs. Cornelins and Baker, of the Franklin Institute, have recently devised a modification of the ordinary electrophorus for lighting gas. It consists of a spherical cup of brass lined with sheepskin and silk, into which drops a corresponding hemisphere of hard india-rubber. The brass cup communicates with a wire near the jet. To light the gas the hard rubber hemisphere is raised by means of a little handle, and the spark passes, lighting the gas in its passage. They have also devised a portable electrophorus of tubular construction. It consists of two brass tubes closed at each end, united together by a ring of hard rubber covered internally with a silk padding. Inside the tubes is a cylinder of hard rubber which passes freely down the tubes when they are reversed. The apparatus is grasped by the non-conducting ring and held upright, the hard rubber cylinder, of course, being at the lower end. Reversal causes it to pass to the other end, charging the brass tube in its passage.

Numerical Relations of Equivalent Numbers.

To the Editor of the CHEMICAL NEWS.

SIR,—I am not aware if the following fact has yet been noticed, viz., that the atomic weights of the elementary bodies are, with few exceptions, either exactly or very nearly multiples of eight:—

$Li = 7$	8
$O = 16$; $N = 14$	$16 = 8 \times 2$
$Mg = 24$; $Na = 23$	$24 = 8 \times 3$
$S = 32$; $P = 31$	$32 = 8 \times 4$
$Ca = 40$; $K = 39$	$40 = 8 \times 5$
$Ti = 50$	$48 = 8 \times 6$
$Ni = 58{\cdot}5$; $Co = 58{\cdot}5$; $Mn = 55$; $Fe = 56$	$56 = 8 \times 7$
$Cu = 63{\cdot}5$; $Zn = 65$; $Y = 64$	$64 = 8 \times 8$
$Sa = 79{\cdot}5$; $Br = 80$	$80 = 8 \times 10$
$Zr = 89{\cdot}5$; $Sr = 87{\cdot}5$	$88 = 8 \times 11$
$Mo = 96$; $Di = 96$	$96 = 8 \times 12$
$Ru = 104$; $Ro = 104$	$104 = 8 \times 13$
$Cd = 112$	$112 = 8 \times 14$
$Sn = 118$; $U = 120$; $Sb = 122$	$120 = 8 \times 15$
$Te = 129$; $I = 127$	$128 = 8 \times 16$
$Ta = 138$; $V = 137$; $Ba = 137$	$136 = 8 \times 17$
$W = 184$	$184 = 8 \times 23$
$Os = 199$; $Hg = 200$	$200 = 8 \times 25$
$Pb = 207$; $Bi = 210$	$208 = 8 \times 26$
$Th = 238$	$240 = 8 \times 30$

It will be observed that there are many of these which exactly agree with this law, viz.:—$O = 16 = 8 \times 2$; $Mg = 24 = 8 \times 3$; $S = 32 = 8 \times 4$; $Ca = 40 = 8 \times 5$; $Fe = 56 = 8 \times 7$; $Y = 64 = 8 \times 8$; $Br = 80 = 8 \times 10$; $Mo = 96 = 8 \times 12$; $Di = 96 = 8 \times 12$; $Ru = 104 = 8 \times 13$; $Ro = 104 = 8 \times 13$; $Cd = 112 = 8 \times 14$; $U = 120 = 8 \times 15$; $W = 184 = 8 \times 23$; $Hg = 200 = 8 \times 25$; and others come very near. It is worthy of comment that elements having the atomic weights $72 = 8 \times 9$; $144 = 8 \times 18$; $152 = 8 \times 19$; $160 = 8 \times 20$; $168 = 8 \times 21$; $176 = 8 \times 22$; $192 = 8 \times 24$; $216 = 8 \times 27$; $224 = 8 \times 28$; and $232 = 8 \times 29$ are wanting, but future discovery may fill these vacancies.

Hoping you will excuse this intrusion on your time,

I am, &c. STUDIOSUS.

June 18, 1864.

A Sad Case.

To the Editor of the Chemical News.

Sir,—Before softening of the brain, which has already set in with uncontrollable vigour, renders me incapable of thinking or writing, permit me to ask your aid in rescuing at least some of my fellow creatures from the unfortunate fate that is about to befall me.

I was brought up under the old system of chemical notation, and believed that water was HO for many years, but having attended a certain lecture at the Royal Institution and another at the Chemical Society, advocating the claims of that interesting liquid to the style and title of $H_2\Theta$, I was so far struck by the logical correctness of the views held by the lecturers that I forthwith vowed to inquire into the subject, and set the doubts raised in my mind at rest, one way or the other. The result of reading every article in all the leading scientific journals of Europe and America has been my entire conversion to the new faith, but, I am sorry to say, at the expense of my reason.

This lamentable result of my search after truth has not been brought about by any difficulty in grappling with the arguments adduced, but simply because scientific writers will not adopt one uniform system in formulating compounds. The confusion resulting is something chaotic. Talk about Mr. Babbage being driven mad by organ grinders! Let him only try to read and understand half-a-dozen consecutive articles on organic chemistry in any current scientific periodical. Or, to go no further, look at water. One writer formulates water HO, another H_2O, another $H_2\Theta$, a fourth *HO*; in one page we find slaked lime appearing as CaO.HO in the next *CaO.HO*, a few lines further on CaHO, then $\mathrm{CaH\Theta}$, then $\mathrm{\not{C}aH_2\Theta_2}$, then $\mathrm{CaH_2O_2}$, until the brain first becomes confused, then swims, and finally softens.

I don't think the blame in this case attaches so much to the editors of these journals as to the authors of the papers, who, from thoughtlessness, imagine that their readers will estimate the symbols they use at the same value that they do themselves. I appeal, therefore, most earnestly to scientific writers to allow their formulæ to be printed in such a manner as to be intelligible to every one. At one time this was accomplished by the double equivalents being indicated by a crossed letter—*e.g.*, $\not{C} = 12$, but this custom gradually gave way, and now no warning whatever is given that the C's, O's, &c., in particular papers, are doubled. Watts, in his magnificent "Dictionary of Chemistry," uses ordinary Roman capitals for the new formulæ, and italics for the old; but now that a third system has sprung up, in which the equivalents of calcium, iron, lead, &c., are doubled, this method will no longer serve. Why should not writers and editors agree, at any rate for the present, to use a thickened letter for the doubled equivalent; this would do away with all confusion, and possibly restore my unfortunate brain to its normal hardness. I give an example:—

CaO HO = Hydrate of lime. Old system.
CaHO = „ calcium. Gerhardt's system.
$\mathrm{CaH_2O_2}$ = „ „ Latest system, as adopted by Kopp, Williamson, Odling, &c.

The idea of the *heavy* equivalent would thus be at once indicated by the *heavy* appearance of the symbol.

My keeper is coming, so I must close my letter.—I am, &c.

An Inmate of Hanwell.

P.S.—My keeper posts this for me. I bribed him by giving him 6d. to regale himself with a glass of brandy and

$$\mathrm{HO}, \mathit{HO}, \mathrm{H_2O}, \mathrm{H_2\Theta}, \left.\begin{matrix}\mathrm{H}\\ \mathrm{H}\end{matrix}\right\}\mathrm{O}, \mathbf{HO},$$

or whatever it is.

[Our correspondent has reason: it would relieve editors of many anxieties if chemists could only agree upon the use of formulæ. Could not an international congress settle the question?—Ed. *C. N.*]

Aërial Rings.

To the Editor of the Chemical News.

Sir,—The interesting experiments of Mr. Tomlinson, referred to in your last number, having drawn attention to the above phenomena, I may be permitted to quote some extracts from my laboratory notebooks, bearing on the subject.

Firstly as to the explosion of gunpowder. We often observe partial and indistinct wreaths on the discharge of heavy ordnance, but on one occasion I saw a strikingly perfect example. Whilst in Paris, in 1855, I was standing near the guns on the Esplanade des Invalides during the firing of a royal salute. The air was quite still, and the entire smoke from one piece burst into a dense oval ring which rose slowly and unbroken for twenty or thirty yards until it melted away. It gradually expanded in diameter, with a marked, though not extremely rapid, rotatory motion. The lively spectators were loud in their exclamations as to its beauty and appropriateness to the occasion, presenting as it did the appearance of a wreath or coronal.

Again, when briskly boiling a portion of a soil with dilute nitro-hydrochloric acid in a glass flask, I have occasionally seen the same effect well produced. In such cases the liquid is apt to boil in starts, and sometimes for hours together, almost every burst of acid steam will form itself into an expanding and rapidly rotating ring, as perfect as those from the deflagration of phosphuretted hydrogen, only not so large or opaque. The flask I employed held about three pints; the neck was long and the mouth about five-eighths of an inch in diameter.

Lastly, as an example of movements, somewhat similar in appearance, I may mention that on fusing a silicate with carbonate of soda in a large platinum crucible at an intense red heat, dark, sharply-defined circular lines are produced on the surface of the liquid, moving spirally inward from the edge to a central point like the figures we see in chromatrope slides. On removing the blow pipe flame this effect continues for some time, only reversed, the revolving lines opening out from the centre to the circumference where the cooling takes place most quickly.

I am, &c.

Frederick W. Griffin, Ph.D.

Bristol School of Chemistry, June 20.

MISCELLANEOUS.

Danger in the Electric Light!—It will scarcely be believed that Mr. W. de la Rue was obliged to insure Willis's Rooms for 20,000*l.* before the electric light could be exhibited at his *soirée*, the office in which the premises were already insured having given the proprietors notice that the company would not hold themselves liable for any damage by fire while the electrical apparatus remained in the building. The ignorance which stimulated this proceeding on the part of the company is something so extraordinary, that, out of charity to other offices, the name should be published. We may mention here that some offices have recently refused to insure buildings in which an apparatus was used for naphthalising gas.

ANSWERS TO CORRESPONDENTS.

J. A. M.—We do not think it can be done in any way.

D. L. J. F.—A common spirit lamp fed with wood spirit will answer every ordinary purpose.

C. H. B., Lancashire.—Chemists have long ceased to hang their theories on pegs, and use brackets instead.

T. N.—The fixed oil is decomposed by heat. Distillation is effected at a temperature of about 600° F. Stearine and olein may be obtained by saponifying tallow with lime and then decomposing the soap with sulphuric acid. The two fats must then be separated by pressure.

Received.—*Mr. Ellis.*—Next week. We shall be glad to hear further from our correspondent.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on Oxygen, by Dr. G. Meissner.

(Continued from page 3.)

The following cuts were intended to accompany the abstract in our last number. Figure 1 will be easily understood as showing the arrangement of the tubes (described at page 2) for electrizing the surrounding air, and needs no further description. Figure 2 represents the apparatus (mentioned at page 3) used by the author for completely drying the air, as well as the ozonising tube and the flasks in which he experimented with the ozonised air. The air from the gasometer first entered the tube *a*, filled with chloride of calcium, and then passed through the flask *e*, which contained English oil of vitriol. By noticing the bubbles as they passed through this flask the rapidity of the current could be seen, and regulated accordingly. From the flask the air passed through the tubes *b*, *b*, *b*, filled with fragments of glass drenched with sulphuric acid; and, finally, before reaching the ozonising tube, through the bent tube *c*, which contained pieces of marble to retain any sulphuric acid. The exit end of the ozonising tube is seen to be bent up and pass through a cork into a larger tube, *f*, where it is surrounded with mercury. A small bell glass or a bent neck of a retort, *g*, dips into the mercury and conducts the ozone to the flasks for experiment.

Fig. 1.

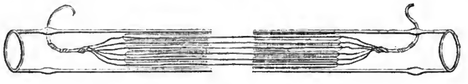
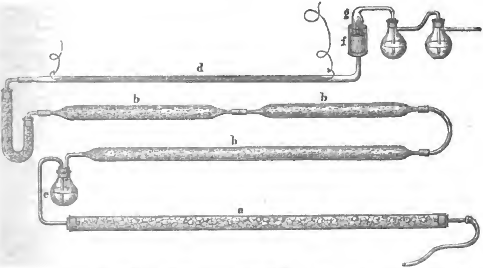


Fig. 2.



We may now continue our account of the author's results.

The cloud or smoke which forms as the ozonised air passes through water, remains on the surface of the liquid, and when the vessel is full and the air of the laboratory is still, may be poured out like carbonic acid. If poured through a tube to the bottom of a dry glass vessel it displaces the air, and the vessel may be filled with the cloud. When a vessel so filled is closed and set aside the mist gradually becomes less opaque, and in the course of thirty or forty-five minutes quite disappears, leaving the air quite transparent. Water, however, is slowly deposited on the sides of the vessel in small drops or dew, which aggregates and flows to the bottom.

When the mist has once disappeared it is impossible to reproduce it with more water, and the air which remains has only the properties of the ordinary atmospheric mixture. The atmizone, therefore, has changed into ordinary oxygen. The water may be perfectly pure, or it may contain substances carried along by the cloud, as will be explained later.

These results prove that atmizone has the property of attracting moisture and giving it the characters of a cloud or mist, and then of depositing it again in the form of droplets or dew, while it is itself changed into ordinary oxygen.

(To be continued.)

On a Colloid Acid; a Normal Constituent of Human Urine, by WILLIAM MARCET, *M.D., F.R.S.*[*]

THE present communication describes the mode of extraction and the properties of an acid of a colloid nature which is always present in healthy human urine, and appears destined to become of great importance in physiological chemistry.

With the view of separating this acid from the urinary secretion, the fluid is mixed with animal charcoal, concentrated, filtered, and the filtrate, after precipitation with baryta-water, is dialysed for about twenty-four hours. The dialysed liquid, after subsequent filtration and concentration, is mixed with basic acetate of lead, which precipitates the colloid acid as an insoluble lead-salt, along with a little hydrochloric acid and other impurities. The precipitate should be thoroughly washed, decomposed with sulphuretted hydrogen, and again treated with animal charcoal. When the acid is required in a pure state, the hydrochloric acid present is removed with carbonate of silver, the excess of the silver precipitated with sulphuretted hydrogen, and after boiling to evolve this last substance, basic acetate of lead is again added. The lead-salt perfectly washed may be considered pure, and the pure acid can be obtained from it by decomposition with sulphuretted hydrogen.

The acid is very slow to decompose when exposed to the air. It may be considered to undergo no loss or decomposition by being boiled, as shown by direct experiment. After concentration by heat, its colour darkens, and it becomes syrupy, possessing a sharp acid taste, with a slight acrid and astringent after-taste; the taste is perceptible in the solution when very dilute: no crystals of the acid could be obtained in the syrup. Dried at a temperature under 212° F., the acid has the appearance of a transparent varnish; it is very hygroscopic, and dissolves readily in water, though not apparently in alcohol, sp. gr. ·820, or in ether. When burnt, the colloid acid chars, emitting a pungent and irritating smell, and after complete combustion, nothing but the minutest trace of inorganic residue remains. Although strictly a colloid, this acid in the free state passes through a dialyser, but not so readily as a crystalloid. When under the form of a compound its property of dialysing appears much diminished. I could not find that it exerted any action on polarised light.[†]

The acid was found to consist only of carbon, hydrogen, and oxygen. I have not yet succeeded in establishing its ultimate quantitative composition, but it appears to be very poor in hydrogen and rich in carbon. The atomic weight of the substance was found by the analysis of its insoluble lead-salt, and of its baryta-salt. I determined the lead in the lead compounds from six different samples of urine; the average on 100 parts was 33·7 of acid. The analysis of the baryta compound yielded on 100 parts 27·8 of acid. Corresponding to the atomic weights—

for the lead compound	Oxide of lead	111·5
	Acid	56·7
		168·2
for the baryta compound	Baryta	76·5
	Acid	29·5
		106·0

It is therefore very obvious that the acid forms two salts, an acid and a neutral salt. We shall adopt the number 28·35 $\left[\text{or } \frac{56{\cdot}7}{2}\right]$ for the atomic weight of the new acid. The fact of there existing two different compounds of the acid explains many chemical phenomena exhibited by this substance and its salts.

The neutral salts of the acid are all soluble.

It forms two lead salts, one which is insoluble in water and containing two equivalents of acid, and one which is soluble in water, and evidently containing one equivalent of acid.

The insoluble compound is obtained by adding basic acetate of lead to an aqueous solution of the acid or of its neutral salts. An excess of the basic acetate redissolves the precipitate, which reappears on the addition of dilute nitric acid, to be finally redissolved in an excess of the mineral acid. The whole of the colloid acid is not, however, precipitated by basic acetate of lead, principally on account of the formation of a certain quantity of neutral acetate of lead, which I found to have the property of dissolving the insoluble colloid lead salt. On boiling a mixture of the insoluble lead compound with neutral acetate of lead, acetic acid was given off, a confirmatory proof of the insoluble lead compound being an acid salt. In this case one equivalent of the colloid acid combines with one equivalent of oxide of lead of the neutral acetate, two equivalents of the neutral lead salt of the colloid acid being thus formed.

$$\mathrm{PbO,2(Acid) + PbO,C_4H_3O_3 = 2(PbO,Acid) + C_4H_3O_3.}$$

This shows that it is not possible to estimate with accuracy the amount of the acid in urine by means of basic acetate of lead.

When the acid is boiled with an excess of hydrated oxide of lead, an insoluble compound is formed. If the acid be in excess, a compound soluble in hot water, but precipitating on cooling, is obtained. I have not yet determined the composition of these two lead salts.

The baryta and lime salts are easily prepared from the carbonates. They contain one equivalent of the acid, are soluble in water, and yield precipitates with basic acetate of lead, nitrate of silver, and protonitrate of mercury and tannic acid; the more concentrated the solution the more abundant the precipitates. A very slight precipitate occurs by adding neutral acetate of lead to salts of the acid. Other reagents fail to yield precipitates.

The acid dissolves silver from the carbonate, but I could not neutralise it perfectly by such means. The lime salt of the acid cannot be entirely decomposed by boiling it with carbonate of silver.

When the acid is boiled with black oxide of copper, copper is readily dissolved.

I endeavoured to determine approximately the quantity of the colloid in a given bulk of the urinary secretion, and extracted from 8 litres 4·46 grammes of this substance, which, however, must fall short considerably of the real amount of the acid present.

It may be considered as existing in all probability in the blood, where there is little doubt that it acts an important part in the phenomena of the secretion of gastric juice, by displacing the hydrochloric acid from chloride of sodium combining with the sodium. The soda salt would remain in the blood, being a colloid compound, while the free hydrochloric acid would find its way into the stomach. An experiment I performed in connexion with this subject bears out the present view.

The formation of the colloid acid appears to result from some transformation of the colloid, a non-nitrogenous constitnent of the liver known as the glucogenic substance. When better acquainted with the chemical composition and physiological relations of the colloid acid of urine I shall be able to give it an appropriate name.

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[*] Read before the Royal Society, June 16, 1864.

[†] This acid does not precipitate egg-albumen. It precipitates caseine, but an excess does not appear to redissolve the precipitate as in the case of acetic acid.

Remarks on the Distillation of Substances of Different Volatilities, by M. Carey Lea.

Some experiments which have been recently published by M. Berthelot recal to me a similar and remarkable case which attracted my attention several years ago.

M. Berthelot distilled 92 parts of alcohol and 8 of water, and found that the distillate at the beginning, middle, and end of the operation contained equal quantities of water and of alcohol.

He distilled also a mixture containing a large quantity of sulphide of carbon and a small quantity of alcohol, and found that the least volatile body, the alcohol, passed over with the first portions of the distillate, so that towards the end of the operation the retort contained sulphide of carbon almost pure.

To these facts, which tend to cast the greatest doubt on all the results obtained by the laborious process of fractional distillation, I now add the following:—

When a mixture containing the chlorides of ethylamine, diethylamine, and triethylamine is distilled with caustic alkali, we should, according to received ideas, expect to find the ethylamine, which is a gas at ordinary temperatures, distil over first. Triethylamine, which is at ordinary temperatures and pressures a liquid, separates as such when a strong solution of its chloride is treated with caustic alkali, and floating on the surface, as I have before pointed out, we would naturally expect to find it principally in the later stages of the distillation. The contrary, however, is the case when the less substituted ammonias predominate in quantity. Almost the whole of the triethylamine passes over in the first portions of the distillate, and subsequent ones, though rich in ethylamine and diethylamine, scarcely contain a trace of triethylamine.—*American Journal of Science*, vol. xxxvii. p. 377.

PROCEEDINGS OF SOCIETIES.

CANTOR LECTURES.

"*On Chemistry Applied to the Arts.*" *By Dr.* F. Grace Calvert, *F.R.S., F.C.S.*

Bones.—Composition of raw and boiled bones. The manufacture of superphosphate of lime. Application to agriculture. Bone-black or char, and their use in sugar refining. *Phosphorus*, its properties, extraction, and employment in manufacture of matches. *Horn* and *ivory*, their composition and applications.

Lecture I.

I shall not take up your time by making many preliminary remarks, but merely state that though the heads of the subject on which I intend to speak are not inviting ones, still we shall find as we progress that the study of the various matters which I shall bring before you is full of interest and instruction. Further, it would be difficult to name subjects which better illustrate the ability of man to turn to profitable account the various materials placed in his hands, or to mention substances which have received more complete and skilful applications than those we shall treat of this evening.

Bones.—The composition of "green bones," or bones in their natural state, may be considered under two general heads, viz.:—the animal matters, consisting of a substance called osséine and a few blood-vessels, and the mineral matters, chiefly represented by phosphate of lime and a few other mineral salts. The composition of bones has been examined by many eminent chemists, but the most complete researches are those, published in 1855, by M. Fremy, who examined bones, not only from various classes of vertebrated animals, but also from different parts of the same animal; and to enable you to appreciate some of his conclusions, allow me to draw your attention to the following table:—[*]

Composition of Bones.

Name of Bone.	Mineral Matter.	Phosphate of Lime.	Phosphate of Magnesia.	Carbonate of Lime.
Femur—Fœtus 6 months	61·0	58·9	..	5·8
" Boy 18 "	61·6	58·0	0·5	2·5
" Woman 22 years	60·1	59·4	1·1	7·7
" Man 30 "	61·2	57·7	1·2	9·1
" " 40 "	64·2	56·1	1·1	10·2
" Woman 80 "	64·6	57·1	1·2	7·5
" " 97 "	60·8	51·9	1·1	9·1
" Lion (young) ..	64·7	60·0	1·5	6·3
" Sheep	70·0	62·9	1·5	7·7
Sperm Whale	62·9	51·9	0·5	10·6
Ostrich	70·0	..	..	..
Carapace of Turtle	64·1	58·0	1·2	..
Codfish	61·1	..	..	..
Stag's horn	61·9	58·1	traces	3·8
Cow's tooth Bone ..	67·1	60·7	1·2	2·9
" " Enamel ..	96·9	90·5	traces	2·2
" " Ivory ..	74·8	70·1	1·1	2·2
Scales of the Carp	34·2	13·7	traces	1·1

The first conclusion drawn by M. Fremy from these researches is, that he found a larger proportion of mineral matter than is generally admitted by chemists. Secondly, that there is no material difference in the composition of various bones taken from different parts of man, or of any one animal, but that age had a very marked influence on composition. Thus, in the bones of infants there is more animal and less mineral matter than in the adult, whilst in old age there is more mineral and less animal matter than in the middle-aged man. The mineral substance which chiefly increases in old age is carbonate of lime. Lastly, he could find no marked difference between the bones of man, the ox, calf, elephant, and whale; whilst in the bones of carnivorous animals and those of birds there is a slight increase in the amount of mineral matter. Allow me now to call your attention to a most interesting query. I hold in one hand the mineral matter only of a bone, which you can see retains perfectly its original form, and in the other hand I have the animal matter only of a similar bone, which also retains the form in which it previously existed, but is flexible instead of rigid. The question, therefore, arises, whether the strength and hardness of bones proceed from these two kinds of matter being combined together, or are their respective molecules merely juxtaposed? The answer is, the latter; for, as you see by this specimen, the mineral matter has been entirely removed without deforming the animal texture. Further, in the fœtus it is found that the bones contain nearly the same proportions of animal and mineral matters as those of the adult. Also, it has been observed by M. Flourens and other eminent physiologists, that the wear and tear of bones during life is repaired by the formation of new bone on the exterior surface of the bone, while the old substance is removed through the interior duct, and that the composition of the new layer is the same as that of the original bone. Let us now proceed to examine the chemical properties of the various substances composing bones, and some of the various applications which they receive in arts and manufactures. The general composition of bones may be considered to be as follows:—

Bones.

Organic Substances.	Blood-vessels	1
	Osséine	32
	Fatty matters	9

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[*] *Annales de Chimie et Physique*, volume 43, pages 79, 83, 84,

Mineral Substances.	Water	8
	Phosphate of lime	38
	Phosphate of magnesia	2
	Carbonate of lime	8
	Various salts	2
		100

The above-named animal matter, *osséine*,—

C	50·4
H	6·5
N	16·9
O	26·2

and which has been erroneously called gelatine, is insoluble in water, weak acids, and alkalies, whilst gelatine presents properties directly reverse. But what has led to this popular error is that osséine, when boiled in water, becomes converted into the isomeric substance commonly called gelatine. As I shall have to dwell on this substance at some length in my next two lectures, I will not detain you now further than to state that osséine is obtained from bones by placing them in weak hydrochloric acid, which dissolves the phosphate of lime and other mineral salts, washing the animal matter (osséine) until all acid is removed, drying it, and treating it with ether to remove fatty matters. I cannot leave this subject without remarking on the extraordinary stability of this animal substance, for it has been found in the bones of man and animal after many centuries, and even in small quantities in fossil bones.

The fatty matter of bones is made useful in the manufacture of soap, railway grease, and in other purposes; it is obtained by taking fresh bones (as bones which have been kept a long time will not yield their grease easily) and placing the spongy parts, or ends of the bones (where most of the fatty matter exists) in large boilers filled with water, which is then carried to the boil, when a part of the osséine is converted into gelatine, and the fatty matter liberated, which rises to the surface, and is easily removed. The bones thus treated are called boiled bones, and receive many important applications, to which your attention will be called in a few minutes. Benzine and bisulphuret of carbon have been used as substitutes for water in the above operation, but the advantages do not seem to have been sufficient to lead to their general adoption.

Mineral Matter of Bones.—These, as the foregoing tables show, are chiefly represented by phosphate and carbonate of lime. The immortal Berzelius was the first to establish the fact that phosphate of lime was the only substance possessing the properties necessary for the formation of bone, owing to the extremely simple chemical reactions which cause the soluble phosphates to become insoluble. Let us trace shortly the sources from whence we derive the large proportion of phosphate of lime which exists in our frames. Several of our most eminent chemists have proved the existence of phosphorus in sedimentary and igneous rocks, and the important part played by phosphorus in nature cannot be better conveyed to your minds than by this extract from Dr. Hofmann's learned and valuable Report on the Chemical Products in the Exhibition of 1862:—"Large masses of phosphorus are, in the course of geological revolutions, extending over vast periods of time, restored from the organic reigns of nature to the mineral kingdom by the slow process of fossilisation; whereby vegetal tissues are gradually transformed into peat, lignite, and coal; and animal tissues are petrified into coprolites, which in course of time yield crystalline apatite. After lying locked up and motionless in these forms for indefinite periods, phosphorus, by further geological movements becomes again exposed to the action of its natural solvents, water and carbonic acid, and is thus restored to active service in the organisms of plants and lower animals, through which it passes, to complete the mighty cycle of its movements into the blood and tissues of the human frame. While circulating thus, age after age, through the three kingdoms of nature, phosphorus is never for a moment free. It is throughout retained in combination with oxygen, and with the earthy or alkaline metals for which its attraction is intense." After these eminently philosophical views by Dr. Hofmann, I will proceed to call your attention to the application of bones to agriculture. Bones are generally used for manuring in one of these three forms,—1st. As ground green bones; 2nd. As ground boiled bones—(that is, bones nearly deprived of their osséine by boiling under pressure, as I shall describe in my next lecture); 3rd. Superphosphate of lime.

Green or raw bones have been used on grass land for a long period, but their action is exceedingly slow and progressive, owing to the resistance of the organic matter to decomposition and the consequently slow solubility of the phosphate of lime in carbonic acid dissolved in water. What substantiates this view is that boiled bones are far more active than the above. It is found that 30 to 35 cwts. per acre of these will increase the crops on pasture land from 10 to 20 per cent. in the second year of their application. But the great advantage which agriculture has derived from the application of bones as a manure has arisen from their transformation into superphosphate of lime, especially applicable to root and cereal crops. To Baron Liebig is due the honour of having first called the attention of farmers (in 1840) to the importance of transforming the insoluble phosphate of lime of bones into the soluble superphosphate, rendering it susceptible of immediate absorption by the roots of plants, and of becoming at once available for their growth. These suggestions of Liebig were rapidly carried out on a practical scale by Messrs. Muspratt, of Lancashire, and J. B. Lawes, of Middlesex; and in consequence of the valuable results obtained by them, the manufacture of artificial manures has gradually grown into an important branch of manufacture in this country. The manufacture of superphosphate of lime is so simple that any farmer possessing a knowledge of the mere rudiments of chemistry can make it for himself, by which he will not only effect great economy, but also secure genuineness of product. All he requires is a wooden vessel lined with lead, into which can be placed 1000 lbs. of ground boiled bones, 1000 lbs. of water, and 500 lbs. of sulphuric acid sp. gr. 1·845 (or concentrated vitriol), mixing the whole, and stirring well for about twelve hours. After two or three days a dry mass remains, which only requires to be taken out and placed on the land by means of the drill, or to be mixed with water and sprinkled on the land. When very large quantities of this manure are required, the plan devised by Mr. Lawes appears to me the best suited. It consists in introducing into the upper end of a slightly-inclined revolving cylinder a quantity of finely-ground boiled bones, together with a known proportion of sulphuric acid of sp. gr. 1·68. As the materials slowly descend by the revolution of the cylinder they become thoroughly mixed, and leave it in the form of a thick pasty mass, which is conducted into a large cistern capable of containing 100 tons, or a day's work. This is allowed to remain for twelve hours, when it is removed, and is ready for use. Most manufacturers find it necessary to add to the phosphate of lime of bones other sources of phosphates, such as coprolites, or the fossil dung of antediluvian animals, which have been found in large quantities in Suffolk, Cambridgeshire, and elsewhere, and contain from 36 to 62 per cent. of phosphate of lime, and from 7 to 38 per cent. of organic matter. Others employ a mineral substance called apatite, containing about 92 per cent. of phosphate of lime, and found also in large quantities in Spain, Norway, France, &c. Others, again, employ guanos rich in phosphate of lime, such as those of Kooria Mooria Islands and Sombrero phosphates. The following is the average composition of the superphosphate of lime of commerce :—

Soluble phosphate . .	22 to 25 per cent.
Insoluble „ . . .	8 „ 10 „
Water	10 „ 12 „
Sulphate of lime . . .	35 „ 45 „
Organic matter . . .	12 „ 15 „

Nitrogen, 0·75 to 1·5 per cent.

The valuable and extensive researches of Messrs. Lawes and Gilbert and Messrs. Boussingault and Ville have not only demonstrated the importance of phosphates to the growth of cereal and root crops, but also that phosphates determine, in a great measure, during vegetation, the absorption of nitrogen from the nitrates or from ammonia, as will be seen by the following table :—

Amount of Nitrogen fixed by Wheat under the Influence of following Salts :—

	Without nitrogenated compounds.	With nitrogenated compounds.
Phosphate of lime and alkaline silicate . . .	8·15	20·08
Phosphate of lime . .	7·25	19·17
Earths and alkaline silicates	5·71	11·16
Earth	3·00	9·50

Bone-black or Char.—In 1800 Löwitz made the interesting observation that wood charcoal possessed the remarkable property of removing colouring matters from their solutions. In 1811 Figuier also observed that animal black had far greater decolorating power than wood charcoal, and bone-black has consequently become one of the principal agents in sugar-refining, and has been the means, more than any other substance, of producing good and cheap white sugars. To give you an idea of the extent to which bone-black is used at the present day for decolorating purposes in the refining of sugar, I may state that in Paris alone it is estimated that about 11,000,000 kilogrammes of bones are used annually for that purpose. The preparation of bone-black is simple in principle. It consists in placing in cast-iron pots about 50 lbs. of broken boiled bones, that is, bones which have been deprived of their fat—of most of their osséine, and piling these pots in a furnace, where they are submitted to a gradually rising temperature during twenty-four hours, such as will completely decompose the organic matter, but not so high as to partly fuse the bones and thus render them unfit for their applications. But a more economical process is generally adopted. It consists in introducing the crushed bones into horizontal retorts, which are themselves in connexion with condensers, the ends of which are brought under the retorts to assist by their combustion in the distillation of the animal matter. By this arrangement not only is char obtained, but oily matters which are used by curriers, and also ammoniacal salts employed in agriculture and manufactures. The extraordinary decolorating action of animal blacks may be considered as partly chemical and partly mechanical—mechanical because it is proved, by some interesting researches of Dr. Stenhouse, to which I shall refer further on, that the action is due to the minute division of the carbon and the immense surface offered by its particles to the colouring matter, char being composed of 90 parts of mineral salts to 10 per cent. of carbon. On the other hand, the action is proved also to be chemical, by the fact that water will not remove the colouring matter, whilst a weak solution of alkali will dissolve it. Dr. Stenhouse's valuable researches not only illustrate fully this fact, but also prove the possibility of producing artificially substitutes for bone-black. In 1857 he published a paper describing the production of an artificial black, called by him aluminised charcoal. This he obtained by mixing intimately and heating finely pulverised charcoal and sulphate of alumina, when he obtained a powerful decolorating agent containing 7 per cent. of alumina, and well adapted for decolorating acid solutions, such as those of tartaric and citric acids, in chemical works. He also prepared what he called coal-tar charcoal by melting one pound of pitch in a cast-iron pot, adding to it two pounds of coal-tar, and mixing intimately into it seven pounds of hydrate of lime, then carrying the whole to a high temperature, allowing it to cool, and removing the lime by washing the mass with hydrochloric acid and then with water, when carbon in a high state of division was obtained, possessing powerful decolorating properties. The following series of experiments by Dr. Stenhouse perfectly illustrate the chemico-physical action of animal black as a decolorating agent. He boiled a certain amount of char and his two charcoals with a solution of logwood, then treated each black separately with ammonia, when the following results were obtained :—Aluminised charcoal yielded no colour ; bone-black but a slight amount ; coal-tar charcoal large quantities. But it would be wrong in me to leave you under the impression that animal black can only remove colours from solutions. Purified animal black—that is to say, animal black deprived of its mineral matters by the action of muriatic acid and subsequent washing—has the power of removing certain bitters from their solutions. Thus Dr. Hofmann and Professor Redwood applied this property with great skill some years ago to the detection of strychnine in beer. Again, Thos. Graham, Esq., Master of the Mint, published a most interesting series of researches, in which he established the fact that purified animal black had the power to remove a great number of saline matters from their solutions, such as the salts of lime, lead, copper, &c.

Revivification of Bone Black.—After a certain quantity of syrup sugar has percolated through the cylinders containing bone-black, the interstices become so clogged with impurities that it loses its power of decolorating the syrup. Sugar refiners are therefore in the habit of restoring the power of their bone-black, generally speaking, by submitting it to a process of calcination, which volatilises or destroys the organic matter fixed by the char. It has been proved by experience that char may undergo this operation about twenty times before its pores become so clogged with dirt as to render it useless. [Here the lecturer described, with the aid of drawings, several of the various apparatus used in sugar refineries for the above process, alluding particularly to that of Messrs. Pontifex and Wood, by which a ton of char is revivified every twenty-four hours.] A new process, however, has been devised by Messrs. Leplay et Cuisinier, which as a whole deserves the attention of refiners, though I am aware that several of the details of their process have been used for some time. The char which has served its purpose in the cylinders, instead of being removed, is treated at once by the following processes :—It is first thoroughly washed, treated by steam to remove all viscous substances, then a weak solution of alkali is allowed to percolate through the char, which removes saline matters and a certain amount of colouring matter, when it is further acted upon by weak hydrochloric acid, which, in removing a certain amount of the lime salts, liberates the colouring matter ; the char is again washed with weak alkali to remove the remaining colouring matter, and lastly the decolorating power of the black is restored by passing through it a solution of biphosphate of lime. It is to be hoped that the high praise bestowed upon this process on the Continent may induce our manufacturers to try it, as they would obtain two distinct advantages by its use. First, the economy of operating at once upon the black and restoring its properties without removing it from the cylinders. Secondly, the prevention of the noxious odours given off during the revivification of char by the ordinary methods. It is interesting to note one of the results of the different employment of char in this country and on the Continent. In England the wear and tear in sugar refinery is constantly repaired by the introduction of fresh char, and there is no spent or old char for sale. In France, on the contrary, owing to the great impurities in their beet-root sugar syrups, and to the use of blood in refinery, the char becomes rapidly clogged with organic matter, and is so completely animalised, that its value as a manure exceeds what the char originally cost the refiner. The result is that French "spent" char is annually exported to the French colonies to the amount of 120,000 tons, and is there used as a manure to promote the growth of the sugar cane. So important is this article of commerce considered, that the French Government have appointed special analytical chemists to determine its value for the trade.

Phosphorus.—I am now about to call your attention to one of the most marvellous and valuable substances ever discovered by chemists. In 1660, Brandt, a merchant of Hamburgh, discovered a process for obtaining phosphorus from putrid urine; but though he kept his secret, a chemist named Künckel published the mode of obtaining it from this fluid. A hundred years later, Gahn discovered the presence of phosphorus in bones; and Scheel shortly afterwards gave a process to obtain it therefrom. The process devised by this eminent chemist was shortly afterwards improved upon by Nicolas and Pelletier, and their method was so completely worked out by Fourcroy and Vauquelin, that it is still the process used in the present day. The preparation of phosphorus consists of four distinct operations:—1st, 80 parts of thoroughly-calcined and pulverised bones are mixed with 80 parts of sulphuric acid, sp. gr. 1·52, to which is then added 400 parts of boiling water; 2ndly, after a few days the clear liquor, containing bi-phosphate of lime, is removed from the insoluble sulphate, and evaporated until it has the specific gravity of 1·5; 3rdly, this liquor is mixed with 20 per cent. of finely-pulverised charcoal, and the whole is dried at a moderately high heat; when, 4thly, it is introduced into an earthenware retort, placed in the galley furnace, and, on heat being slowly applied, phosphorus distils, and the operation is continued at a high heat for several days. It is, however, necessary that the phosphorus thus obtained should be purified, and this is effected by melting the phosphorus under water, and pressing it through a chamois skin. It is then boiled with caustic alkali to remove other impurities, but what is still better is to heat the phosphorus with a mixture of bichromate of potash and sulphuric acid. The phosphorus thus purified is drawn through slightly conical glass tubes by the suction of a caoutchouc pouch, or is allowed to run, by an ingenious contrivance, into tin boxes. As will be seen by the following formula, the manufacturer only obtained from the bones one-half of the phosphorus they contain:—

$$\underset{\substack{\text{Bone phosphate}\\ \text{of lime.}}}{2(PO_5,3CaO)} + \underset{\substack{\text{Sulphuric}\\ \text{acid.}}}{4SO_3HO} = \underset{\substack{\text{Acid phosphate}\\ \text{of lime.}}}{2(PO_5CaO,2HO)} + \underset{\substack{\text{Sulphate}\\ \text{of lime.}}}{4(SO_3CaO)}.$$

$$\underset{\substack{\text{Bi-phosphate}\\ \text{of lime.}}}{2(PO_5CaO)} + \underset{\text{Carbon.}}{5\,C} = \underset{\substack{\text{Pyrophosphate}\\ \text{of lime.}}}{PO_5\,2\,CaO} + \underset{\substack{\text{Oxide}\\ \text{of carbon.}}}{5\,CO} + \underset{\text{Phosphorus.}}{P}$$

Consequently many attempts have been made to devise a chemical reaction by which the whole of the phosphorus might be secured. The most successful attempt of late years is that made by Mr. Cary-Montrand, whose process is based on the following chemical reaction:—

Action of Hydrochloric Acid on Bone Phosphate.

$$\underset{\substack{\text{Bone Phosphate}\\ \text{of Lime.}}}{2(PO_5CaO)} + \underset{\substack{\text{Hydrochloric}\\ \text{Acid.}}}{4HCl} = \underset{\substack{\text{Acid Phosphate}\\ \text{of Lime.}}}{2(PO_5,CaO,2HO)} + \underset{\substack{\text{Chloride of}\\ \text{Calcium.}}}{4CaCl}$$

Action of Hydrochloric Acid on Biphosphate.

$$\underset{\substack{\text{Biphosphate}\\ \text{of Lime.}}}{2(PO_5,CaO)} + \underset{\substack{\text{Hydrochloric}\\ \text{Acid.}}}{2HCl} + \underset{\text{Carbon.}}{12C} = \underset{\substack{\text{Chloride of}\\ \text{Calcium.}}}{2CaCl} + \underset{\substack{\text{Oxide of}\\ \text{Carbon.}}}{12CO} + \underset{\text{Hydrogen.}}{2H} + \underset{\text{Phosphorus.}}{2P}$$

He arrives at this result by treating calcined bones with hydrochloric acid; the liquor is then mixed with charcoal, and the whole dried at a moderate heat. The prepared mass is then introduced into cylinders through which a stream of hydrochloric acid is made to percolate, and, as shown above, chloride of calcium, hydrogen, carbonic oxide, and two proportions of phosphorus are produced. (The process of Fleck was also described.) Phosphorus prepared and purified by the above processes is a solid, semi-transparent body, having a sp. gr. 1·83, fusing at 110·5° F., and boiling at 550°. It is so inflammable that it ignites in the open air at several degrees below its fusing point; but Professor Graham made, some years ago, the interesting observation that this slow combustion of phosphorus could be entirely checked by the presence of certain combustible vapours. Thus he found that one volume of vapour of naphtha in 1820 of air, or one volume of vapour of oil of turpentine in 4444 of air completely prevented the spontaneous combustion of phosphorus. Further, phosphorus presents the curious property that, if heated to 160° F. and suddenly cooled, it becomes black, and if heated to 450° or 460° for several hours it becomes amorphous, and of a dark brown colour. This allotropic state of phosphorus, first noticed by Schrotter, has enabled it to render great service to society, owing to its not being spontaneously inflammable (as, in fact, it only becomes so at a temperature approaching its point of fusion), and also to its not being poisonous, so that it can be substituted for common phosphorus in the manufacture of matches with great advantage. Lastly, owing to this brown amorphous phosphorus not emitting any vapours, those employed in the manufacture of chemical matches now avoid the risk of the dreadful disease of the jaw-bone, called phospho-necrosis. Notwithstanding the great difficulties attending the manufacture of this valuable product, Mr. Albright, of Birmingham, has, with praiseworthy perseverance and great skill, succeeded in obtaining it perfectly pure on a large scale, and at such a price as to bring it within the scope of commercial transactions.

Chemical Matches.—Although I do not intend to enter at great length upon this subject, yet, as it is a highly important one, I deem it my duty to lay a few facts before you. The first application of chemistry to the discovery of a substitute for the old tinder-box of our fathers, was made in 1820, when the sulphuretted ends of matches were covered with a mixture of chlorate of potash, licopodium, and red lead, and the matches so prepared were dipped into asbestos moistened with sulphuric acid. In 1836, lucifer matches were first introduced, and the explosive matches were soon followed by the non-explosive ones. The composition of these matches is as follows:—

	Non-Explosive.	Explosive.
Phosphorus . . .	25 or 30	9 or 4
Red lead	5 „ 20	16 „ 3
Nitre	0 „ 0	14 „ 10
Sand	20 „ 20	
Vermilion . . .	1 „ 0	
Gum or glue : . .	20 „ 25	16 „ 6

The danger as well as the disease attendant on this manufacture was greatly mitigated by Professor Graham's discovery of the property of turpentine vapour already alluded to. Until lately the only successful application of amorphous phosphorus to lucifer matches was that of Messrs. Coignet, Frères, of Paris, who caused a rough surface to be covered with it, and so prepared their matches that they would not ignite except when rubbed upon the prepared surface. Similar matches, under the name of "special safety matches," have also been introduced into this country of late by Messrs. R. Letchford and Co., who have also effected several important improvements in this branch of manufacture, in one of which paraffine is made use of to carry combustion to the wood, instead of sulphur, which gives rise to the noxious fumes of sulphurous acid, and as the substitution is made by Messrs. Letchford without any increase of cost, the price of these matches is as low as that of the common ones. These gentlemen have also found the means of diminishing the amount of phosphorus used to a very considerable extent, so that the disagreeable smell of this substance is also avoided. But the greatest improvement that Messrs. Letchford have made is in what they call their hygienic matches, or lights, in which, for the first time, amorphous phosphorus is substituted for ordinary phosphorus, and in small quantities. The advantages of these matches cannot be overrated, for children can eat them with impunity, as amorphous phosphorus is not poisonous; they are not nearly so combustible, and, therefore, not so likely to cause accidental fires; and lastly, all source of injury to the health of those employed in the manufacture is removed. I cannot leave this subject without still drawing your attention to one or two important facts. Messrs. Hochstetter and Canouil, besides others, have lately introduced chemical matches free from phosphorus, which are stated to have the following composition:—

Chlorate of potash . . .	10	10	10
Hyposulphide of lead . .	26	26	20
Peroxide of lead . . .	—	9·8	—
Peroxide of manganese . .	—	—	33·6
Chromate of lead . . .	17	4	8·8
Gum arabic	4	4	4

An important improvement in the manufacture of chemical matches is the reduction of the proportion of phosphorus to a minimum. This is effected by reducing the phosphorus to an infinitesimally minute division, by which the manufacture is rendered more economical, and the matches, when ignited, have less of the unpleasant odour of phosphorus. This division is accomplished by using a solution of phosphorus in bisulphuret of carbon, by which a saving of $\frac{18}{20}$ths of the phosphorus is obtained. Another invention is that of Messrs. Puscher and Reinsch, who have proposed the employment of sulphide of phosphorus.

Ivory.—The lecturer, having given some details respecting the properties of ivory, said: I will now call your attention to the substitution of the following mixture for ivory tablets as applied in photography. Finely-pulverised sulphate of baryta is mixed with gelatine or albumen, compressed into sheets, dried, and polished; these sheets are ready for use in the same way as ivory plates. You are all doubtless aware that the nut of the *Phytolephas macrocarpa*, of the palm tree tribe, has for many years been used in this country as a substitute for ivory, and it may be interesting to you to be made acquainted with the two following facts, viz., that the nut is composed of—

Pure cellulose . . .	81	per cent.
Gum	6	,,
Nitrogenated principles . .	4	,,
Water	9	,,
Total . . .	100	

and Dr. Phipson has recently published a method of distinguishing this vegetable ivory from the animal one by means of sulphuric acid, which gives a beautiful purple colour with the vegetable ivory, but none with the animal ivory.

Horn.—The best quality of horns, and especially the beautiful ones obtained from the buffaloes in India and America, receive a great variety of application at the present day, owing to their great toughness and elasticity, as well as to their remarkable property of softening under heat, of welding, and of being moulded into various forms under pressure. To apply horns to manufacture they are treated as follows:—They are first thrown into water, and slight putrefaction commences, by which ammonia is produced, when the horn begins to soften. To carry this action further the horns are transferred into a slightly acid bath, composed of nitric and acetic acids, with a small quantity of various salts. When the horns are sufficiently softened, which requires about two weeks, they are cleaned and split into two parts by means of a circular saw, and these are introduced between heated plates, and the whole subjected to an intense pressure of several tons to the square inch. The plates may be moulds, and thus the horn may be compressed into any required shape. A great improvement has recently been effected in this branch of manufacture, which consists in dyeing the horn various colours. To accomplish this the horn is first dipped into a bath containing a weak solution of salts of lead or mercury, and then rubbing upon the horns impregnated with metallic salts, a solution of hydrosulphate of ammonia, when a black or brown dye is produced. Another method consists in mordanting the horn with a salt of iron, and dipping it in a solution of logwood. Of late very beautiful white fancy articles have been produced from horn by dipping it first in a salt of lead and then into hydrochloric acid, when white chloride of lead is fixed in the interstices of the horn, which then simply requires polishing.

This lecture, as well as those which followed, were illustrated by numerous specimens and experiments.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture XI.—*Thursday, January* 28.

Ladies and Gentlemen,—We will proceed this morning with the subject of coal. I endeavoured on the last occasion to explain that all varieties of coal, including peat and lignite, might easily be deduced chemically from woody tissue by the elimination of marsh gas, carburetted hydrogen, carbonic acid, and water. This might be rendered clear to demonstration by bringing before you a number of formulæ, but I trust you will take my word for the result, as a lecture of this kind is hardly the occasion for the discussion of such formulæ.

Nitrogen is also found in coal. I know no exception at present. It generally exists to the extent of about 1 or 2 per cent. Sulphur, likewise, is always there, and it exists in several distinct states—as iron pyrites—bisulphide of iron, sometimes finely diffused through the coal so as scarcely to be visible, and at other times existing in thin laminæ or small particles, or in nodules, and occasionally even as beds of one or two inches in thickness, or more than that. It is there as sulphate, the sulphur being in the form of sulphuric acid combined with bases,—as sulphate of lime, for example. It is also present in a state of organic combination, just as we find sulphur existing in fibrin or albumen on various azotised organic tissues. This, I think, has been proved to demonstration by analysis. We have examined coals, and determined the proportion of iron contained in the ash, and also the absolute amount of sulphur in the coal, and we find that occasionally there is much more sulphur than can be accounted for by the iron pyrites present. Further, we find that it cannot be explained in such cases by the existence of sulphates. It must, therefore, exist in a state of organic combination.

All coal contains a certain amount of inorganic matter or ash, derived partly from the mineral constituents of the plants from which the coal has been generated, and also in part from earthy matters which have been washed in during the time of the formation of the coal. Accordingly, if we examine the composition of the ash of coal and that of the bed and roof of a coal-pit, we shall find that the ash has in many cases almost identically the same composition as the matters forming the bed and the roof. This has been very clearly shown by Mr. Taylor, who has given us several excellent analyses illustrative of the fact.

The iron pyrites in coal is subject to spontaneous decomposition. It is oxydised by the action of moist air, and becomes converted into what is called misy—a yellow basic sulphate of sesquioxide of iron. If we open an old colliery, for example, we find little patches of these substances here and there. The combustion of iron pyrites generates much heat, and occasionally causes the spontaneous ignition of the coal—an accident occasionally attended with great loss, especially in the South Staffordshire district. I might here take occasion to observe that I am disposed to believe that there is another cause of spontaneous ignition similar to that which determines the spontaneous combustion of cotton waste—namely, the absorption of oxygen by coal reduced to a fine state of division. M. Marsilly, who has charge of a railway department in the north of France, has made some curious observations upon coal with reference to the presence of marsh gas in it. Certain coal—in fact, coal generally—when exposed to a gentle heat, or even in *vacuo*, evolved inflammable gaseous matter, and also a little liquid matter—I will not say resinous, but reminding one of the odour of benzine, too small to be investigated at present. He says also that only certain coals evolved this combustible gaseous matter, and he has met with coal, from which only carbonic acid and nitrogen could be obtained. "Therefore," he says, "by the examination simply of a piece of coal in this way, I can at once state whether fire-damp will be found in a colliery or not." This accords, to a certain extent, with our experience. We know that there are certain coal-fields which are apparently free from fire-damp; but at present we are unable to explain the cause of the absence of carburetted hydrogen. There must, of course, be some local peculiarity to account for it; but, as far as I know, this point has not yet been the subject of investigation. The explosions which we hear of from time to time in ships laden with coal are due to the gradual escape of the carburetted hydrogen contained in the coal, its admixture with atmospheric air, and its subsequent ignition.

With regard to the varieties of coal much might be said. I shall, however, content myself with very few remarks upon the subject. We have, first of all, the lignites—a very extensive series—which are not classed ordinarily by geologists as coal proper, inasmuch as they do not belong to the carboniferous series; but in many respects they very closely resemble coals, and chemically they certainly are coals, and some, if I mistake not, are identical in composition with coals from the true coal measures. These lignites vary much in external character—some, we find, presenting the appearance of wood, and others being so coal-like that we cannot distinguish from true coal. Occasionally they are, more or less, schistose and earthy. Their colour varies from brown to deep black. They are all, more or less, brittle. Some of them are remarkable as containing a large amount of iron pyrites, which causes them speedily to weather, and various very offensive products are driven off by the distillation on burning of such lignites. You remember I pointed out one peculiarity which, I think, is deserving of your attention—namely, that lignites generally contain a large amount of water; and so far they approximate in character to wood. This is a point which has not been sufficiently dwelt upon, I think, by geologists. We have found sometimes 15, 18, or 20 per cent. of hydroscopic water. The lignite to the eye and to the touch will appear perfectly dry like a piece of dry wood; but yet on the application of a gentle heat all this water may be expelled, as in the case of wood. This water not being water displaced from combination may be reabsorbed by the exposure of the lignite to the air. I may mention to you the occurrence of magnificent lignites in Trinidad, about which a monograph has been written, together with a statement concerning their geology, by Mr. Wall, a gentleman formerly a student of this Institution. They are very remarkable lignites. The mineral pitch which has been produced there has been derived from those deposits by the application of heat.

We have several distinct varieties of coal occurring in this country.

First comes the large class of bituminous coals, which burn with a smoky flame. The term "bituminous" has been used in a very indefinite sense, for such coals contain no bitumen properly so-called—that which mineralogists designate bitumen. The term bitumen has been used by some persons to designate the volatile constituents of coal, or those constituents which are expelled when the coal is exposed to a red heat in a close vessel. These bituminous coals may be divided into two very distinct classes, with regard to their mode of burning. First, we have those which are non-caking; secondly, those which are caking. By "non-caking" I mean coals which, when heated, do not soften and consolidate so as to form a solid coke. By "caking," I mean those coals which, by heating, become converted into a solid coke. They seem to soften and agglutinate. The coals which we burn in London, and which are obtained from the North of England, are caking coals properly so-called. The non-caking coals we find in Staffordshire and other parts of England. With regard to their constitution, they may be divided into two very distinct groups—namely, those which are rich in oxygen, such as South Staffordshire coals, containing about 15 per cent. of that substance, and those which are poor in oxygen. The latter are typified by certain coals in South Wales. These form two very distinct classes. We have, as the final term of the series, "anthracite," which occurs abundantly in South Wales and in the United States of America. This anthracite may be practically regarded as pure carbon. I use the word "practically." It contains a very large amount of carbon, but there is always present some hydrogen, some oxygen, and some nitrogen. Even in the best and most characteristic anthracite I have found as much as about one per cent. of nitrogen; but in a practical sense anthracite may be regarded as carbon, and it is the final term of the series. These coals are shining black, breaking with a conchoidal fracture, not staining the fingers when touched as ordinary bituminous coals do. Some anthracites decrepitate remarkably when heated, however carefully. We have had specimens of this kind from the Vale of Neath, which, when heated even gradually to redness, become reduced to an almost impalpable dust. This is a source of great inconvenience in the application of such coals—to the smelting of iron, for example. In fact, it is one of the chief reasons why anthracite has not been used successfully in this country for that purpose. It has been used, we all know, but not successfully in the proper sense of the term "success," owing to this curious decrepitation—this splitting into minute fragments, which accumulate to such an extent in blast furnaces after a time as to seriously impede the operation of the blast, preventing its passage through the mass. In the United States, on the other hand, I believe anthracite occurs which does not decrepitate to the extent of our own anthracite, and it is extensively and successfully used for the purpose of smelting.

While referring to anthracite, I may mention the semi-anthracitic varieties of coal of which the South Wales people speak, which are a close approximation to anthracite, and are well adapted for steam navigation. Only a short time ago we had an opportunity of examining some steam coal from China, sent by the Admiralty, and amongst them was a magnificent steam coal, equal to any occurring in South Wales.

In coals we find occasionally certain foreign matters. Among these I may mention the beautiful resinous substances which we have found. I have placed specimens before you of all these. I have had occasion to examine a good many during the last few years. Here, for example, is a beautiful mass of resin from a lignite or coal found in Tasmania. It might be mistaken for common copal. Amber occurs extensively in some lignites—as in those from Greenland, for example. These substances are the resinous exudation in former times of the trees and plants from which the coal has been derived.

With regard to foreign matters in coal, I have already mentioned the presence of lead, occurring, as galena, sometimes in distinct nodular masses. Arsenic also has been found in coal. Dauhrée in the examination of certain lignites has met with distinct traces of arsenic. He also informs us that he has found both arsenic and antimony in the coal of Newcastle-on-Tyne, and occasionally copper and antimony. We have found distinct traces of arsenic in a coal from Nottinghamshire. The anthracite of South Wales which we have been using here for many years is generally impregnated with distinct traces of copper. This is a subject of inquiry which has not been yet very extensively investigated.

In concluding this subject of mineral fuel, I might mention Fremy's researches on combustible minerals. He has attempted to determine the age of coal by certain chemical actions. Thus he says with respect to lignite that the varieties known as bituminous wood are, like peat, soluble in alkalies, but they dissolve almost completely in nitric acid and the hypochlorites. Compact and black varieties resembling bituminous coal are, in general, not acted upon by alkalies, but dissolve completely in hypochlorites and in nitric acid. Bituminous coals, he says, do not dissolve in alkaline solutions, or in hypochlorites; but bituminous coals and anthracite dissolve completely in a mixture of monohydrated sulphuric acid and nitric acid. It is entirely thrown down by the addition of water. I made some experiments upon this subject with reference to Fremy's researches, but not to a sufficient extent to justify any very positive conclusion on the subject. I am not, however, disposed to attach very much weight to them.

I will call your attention to one experiment concerning the artificial production of a substance very much like anthracite by Dauhrée. He heated fragments of fir in a close tube along with water, at a high temperature, and, therefore, under great pressure, when it was transformed, he says, into a black mass having a bright lustre, perfectly compact, and, in fact, resembling pure anthracite; it was so hard that a steel point scratched it with difficulty. This is a curious experiment, and one well worthy of note. We find in our coal pits, occasionally, the intrusion of a most unwelcome visitor in the form of trap, a rock of igneous origin. The coal in the vicinity is more or less coked. It does not present the least appearance of anthracite, nor do I suppose it possible that anthracite could have been produced simply by the operation of heat in this way, by a coking operation. There is also another reason which would render this view extremely difficult to explain. If anthracite were nothing but bituminous coal deprived of the certain proportion of its volatile matter so called, by the application of heat, then we ought to find a considerable proportion of ash in such coal, which is not the fact. We occasionally meet with anthracites containing a very small proportion of ash. There must, therefore, be some other condition to explain the circumstance, and that condition will probably be found in the action of water at a high temperature. That, however, is a mere speculation at present.

We now arrive at the subject of fossilisation—one of considerable interest. Fossilisation is the perpetuation, or the conversion—(I will take that word in preference)—of the frames of plants and animals into stone-like substances, whereby their forms are retained, sometimes with remarkable perfection. It is requisite to distinguish carefully between fossilisation and incrustation. Incrustation is a process we very often see, as, for example, at Matlock Bath, where a spring water occurs richly impregnated with bicarbonate of lime. That water, on exposure to the air, loses a portion of its carbonic acid. The carbonate of lime, consequently, becomes insoluble, and is thrown down in the form of a deposit. The same process takes place with waters at Carlsbad. You may see specimens of the result in the museum above. That, however, is not fossilisation. This deposition is sometimes called incrustation, but is more frequently spoken of erroneously as "petrification." One frequent incrusting matter is carbonate of lime. Silica is another; and at St. Michael's, in the Azores, there is a stream containing so much silica that plants in it are said to have their tissues replaced entirely by silica. Carbonate of protoxide of iron, gypsum, brown iron ore, iron pyrites, and carbonate of zinc are also found occasionally acting as incrusting matters. There is one specimen in the case in the museum above well deserving of attention, where incrustation has occurred by the percolation of water containing carbonate of zinc.

We have a filling of the casts of fossils with various matters. Sometimes they are filled with the same stuff as that in which they occur, for example, sandstone with sandstone. Sometimes they are filled with another kind of matter, as in the echinus in the chalk, the interior of which becomes filled with flint, while the shell is changed into calc spar. Yet this has occurred in the chalk itself.

Fossilisation takes place by various agents. There is fossilisation by carbonate of lime in the form of calc spar, or as fibrous or compact carbonate of lime. In shells of living animals the carbonate of lime is either amorphous or in the state of arragonite. In the crinoids the stems break with a curious rhombic fracture, and each joint seems to represent, as it were, a distinct crystal, and the internal alimentary canal is always the main axis of the crystal. If we break a series of joints in the same animal in succession, we find that every joint is slightly turned at a certain angle, but we do not find that the cleavage planes are parallel. If all the joints were cleaved a spiral series of cleavage planes would be presented. The same is true of echinus spines when similarly converted into calcspar. That is a very curious point.

Fossilisation occurs with silica as in the case of wood. Here is a specimen of an endogenous tree partially silicified. The wood has been removed, and replaced by particles of silica. Every trace of the structure is distinctly visible under the microscope. It is one of the common forms of silicification. When shells imperfectly silicified are acted upon by an acid the outer part resists, for it is this which consists mainly of silica, but the interior dissolves. Thus silicification takes place always from the exterior inwards.

Iron pyrites partially or wholly replaces organic remains. We find magnificent specimens of this in the ammonites, of which several are placed before you. In bivalve shells we do not meet with this replacement, and there seems to be a good reason for it. The iron pyrites appears to be generated by the action of the decomposing organic matter upon sulphates in solution in water. Of course there must also be iron present at the same time. In the case of bivalve shells this matter speedily escapes and flows away or is otherwise removed, and therefore we do not find replacement by pyrites.

Replacement also takes place by means of hydrated sesquioxide of iron, pseudo-morphous after iron pyrites. I think I mentioned this on a former occasion. Iron pyrites is not unfrequently found converted into hydrated sesquioxide of iron by weathering action under certain specific conditions. It is formed also by deposition from springs, for when spring water which contains carbonate of iron—(protoxide of iron dissolved by the aid of carbonic acid)—is exposed to the action of the air, the iron becomes peroxidised, being converted into sesquioxide of iron, and in that state it no longer contains carbonic acid, which escapes, and we have a deposit of hydrated sesquioxide of iron. This is the way in which fossilisation may occur from this mineral.

It occurs also from red iron ore, and even from specular iron ore, as well as from sparry iron ore.

Gypsum is occasionally found replacing shells, which have been completely changed into it. This occurs in the stratum of fossiliferous gypsum in the Keuper formation in Würtemburg. There are also gypsum casts of shells in Montmartre, near Paris.

Here I may take occasion, ladies and gentlemen, to express my regret that this institution, which, above all others, ought to have a fine collection of specimens illustrative of fossilisation, has but very few of the kind. I do hope that before long we shall have a suitable collection to illustrate the phenomenon of replacement by these various substances. It is one of extreme interest and importance in its geological relations.

I may place before you a very pretty series of specimens presented to the institution by Mr. Sorby. They illustrate the various modes of pseudo-morphism. We have the fact of such changes clearly established. The more or less complete conversion of the mass into the superficial substance is entirely a matter of time.

Vivianite, or the blue phosphate of iron, is met with in shells occurring in the Black Sea. It is found also in New Jersey, where belemnites and bivalves are found almost, if not completely, transformed into vivianite.

Fluor spar is also met with as an agent in fossilisation. Encrinital stems in the carboniferous limestone of Derbyshire are met with converted into fluor spar.

Fossils of sulphate of beryta occasionally occur, for instance, in the lias in France, and in ammonites at Whitby. They occur also in the tertiary at Kreuznach, in Prussia. I have seen sulphate of baryta several times in iron ore in South Staffordshire. The cracks have been filled with a white matter, which has been found to be that substance.

Sulphate of strontia is another substance, forming fossils. Fossils of this substance have been found in the Tyrol and in France.

Sulphate of lead has been found in fossils at Semur in France, and elsewhere.

Carbonate of lead is also found as a fossilising agent. It occurs in criniods in limestone in Poland, traversed by a vein of galena.

Fossilisation takes place by blende, and also by carbonate of zinc. It occurs with vitreous copper—that is, the sulphide of copper in the case of certain seeds in Hessen. By copper pyrites, it occurs in various localities. It takes place with cinnabar in the case of some fish remains at Münsterappel, Bavaria, and with talc and pyrophyllite. Glauconite, or green silicate of copper, is another agent in fossilisation, as in the case of certain infusorial fossils. Fossilisation occurs also by means of the mineral pinguite; and it occurs even by sulphur in a fresh-water formation in Arragon, with the remains of planorbis and char. It takes place also by means of anthracitic carbon in the interior of cephalpoda at Kertch.

We may dismiss this subject of fossilisation, which is one of great interest in many respects.

(To be continued.)

ACADEMY OF SCIENCES.

June 27.

A LETTER from MM. Wöhler and G. Rose stated that they had been making experiments *on the Colouring Matter of the Emerald.* Lewy, in 1858, asserted that this colouring matter was organic, and was destroyed by heat—a result which the authors of this letter could not confirm. They kept an emerald at the temperature of melted copper for an hour, and found that, although the stone became opaque, the colour was not affected. They fused, however, some colourless glass with an exceedingly small quantity of oxide of chromium, and produced a colour exactly like that of the emerald. They therefore considered this substance the colouring agent, without, however, denying the presence of some organic matter.

MM. J. and Jules Persoz contributed some "*Observations on the Nature of Tungsten,*" a metal generally considered of an anomalous character. The authors sent a sealed paper, and all they tell us now is that they are in a position to announce the existence of several distinct radicals in tungsten, which give rise to various acids, one of which is perfectly white, and contains very different proportions of oxygen. One of these elements forms two compounds with oxygen, both having well-characterised basic properties, and furnishing salts,—the lower oxide, colourless salts, and the higher oxide, salts of a yellow colour, like that of chloride of gold. The processes by which they have separated the radicals and obtained the salts are detailed in the sealed paper, the opening of which we shall await with much curiosity.

M. Jaillard contributed a paper "*On the Electrolysis of Vinic Alcohol.*" The author made the alcohol conduct by adding to 100 parts one part of SO_3HO, and one part of KOHO. The liquid was then electrolised by ten large Bunsen's cells. Hydrogen was obtained at the negative pole, while the positive seemed inactive. But the liquid acquired a smell very much like that of aldehyde, and on submitting it to distillation the author collected a small quantity of fluid which he recognised as the body named by Gerhardt *hydride of acetyle.* The following equation, he believes, explains the decomposition:—

$$\underbrace{C_4\,H_6\,O_2}_{\text{Alcohol.}} = \underbrace{C_4\,H_4\,O_2}_{\text{Hydride of acetyle.}} + H_2.$$

M. Cahours presented a note "*On the Respiration of Flowers.*" This was an interesting paper, in which the author shows that while the green parts of plants under the influence of light absorb carbonic acid, assimilate the carbon, and give out oxygen, the coloured parts, on the contrary, under the same circumstances, absorb oxygen, and give out carbonic acid. The amount of carbonic acid evolved seemed to increase as the temperature rose; and a growing flower gave out more than a fully blown one.

A note by M. Debray, "*On the Dimorphism of Antimonious and Arsenious Acids,*" gives an account of methods by which both these acids may be obtained either as regular octohedra or rhomboidal prisms. These two latter papers deserve reproduction.

NOTICES OF BOOKS.

Memoirs of Distinguished Men of Science of Great Britain Living in the Years 1807-8, and Appendix. With an Introduction by ROBERT HUNT, F.R.S., &c. Compiled and arranged by WILLIAM WALKER, junior. Second Edition. London: E. and F. N. Spon. 1864.

THIS is a series of very short and rather dry biographies, introduced by a little fine writing by Mr. Robert Hunt. The book we notice is intended as a companion to the engraving by Mr. Walker, senior. Apart from this, however, it possesses some value as offering, in a small space, a careful and accurate record of the men who made the commencement of the present century a marked epoch in the history of the progress of science.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

563. Thomas Gray, Mitcham, Surrey, "Improvements in the treatment of 'jute' and 'jute' cuttings."—Petition recorded March 5, 1864.

819. Stephen William Silver, Bishopsgate-street, London, "Certain machinery for extracting the juice of the *sapota mulieri*, or bullet tree."—A communication from John Thomborrow Manifold, Demerara, British Guiana.—Petition recorded April 2, 1864.

1443. Charles Hill Snell, Bow-common, Middlesex, "Improvements in the manufacture of soaps and saponaceous compounds."—Petition recorded June 10, 1864.

1484. John Anthony Pols, St. Martin Street, Leicester Square, Middlesex, "Improvements in obtaining purified or refined oils, and in obtaining oil cakes and foots useful for soap making."—Petition recorded June 15, 1864.

Invention Protected for Six Months by the Deposit of a Complete Specification.

2564. George Haseltine, Southampton Buildings, Chancery Lane, Middlesex, "Improvements in apparatus for smelting and reducing ores and metals."—A communication from Loomis George Marshall, Philadelphia, Pennsylvania, U.S.A.

Notices to Proceed.

406. Edward Moore, Tewkesbury, Gloucestershire, "Improvements in the manufacture of Surgical bandages."

408. Henry Newmane, Hortulan Villa, Shrewsbury, Shropshire, "A new medicinal compound pill for diseases of the liver."—Petitions recorded February 17, 1864.

419. John Travis, Luzley Brook, Royton, Lancashire, "An improved method of preventing and curing corrosion, and preserving the metal in steam boilers, steam generators, and fuel economisers." — Petition recorded February 18, 1864.

454. Eugène Alphonse Cotelle, Boulevart St. Martin, Paris, France, "An apparatus for concentrating and distilling sulphuric and other acids, and all solutions in general."—Petition recorded February 23, 1864.

470. Thomas Rowatt the younger, and Alexander Lightbody, Edinburgh, N.B., "Improvements in lamps for burning paraffin, belmontine, petroleum, and other like hydrocarbon fluids."

474. Henry Carter, Camberwell New Road, Surrey, "Improvements in the manufacture of green colouring matters to be used in dyeing and printing."—Petitions recorded February 26, 1864.

490. Frederick Ransome, Ipswich, Suffolk, "Improvements in the manufacture of artificial stone."—Petition recorded February 27, 1864.

552. Alexandre Manbré, Baker Street, Portman Square, "Improvements in the manufacture of glucose sugar."—Petition recorded March 4, 1864.

568. William Edward Newton, Chancery Lane, Middlesex, "Improvements in refining sugar and molasses."—A communication from L. P. R. De Massy and L. R. De Massy, Rue St. Sebastien, Paris, France.—Petition recorded March 7, 1864.

580. William Edward Newton, Chancery Lane, Middlesex, "Improvements in the manufacture or production of baryta and strontia."—A communication from L. P. R. De Massy and L. R. De Massy, Rue St. Sebastien, Paris, France.—Petition recorded March 8, 1864.

1128. John Thompson, Hilldrop Crescent, Camden Road, Middlesex, "Improvements in apparatus for securing stoppers in bottles."—Petition recorded May 4, 1864.

1426. Ferdinand Henry Werlich, Maze Hill, Greenwich, Kent, "Improvements in the manufacture of artificial block fuel and coke, and in apparatus employed therein."—Petition recorded June 8, 1864.

CORRESPONDENCE.

Continental Science.

Paris, July 6th, 1864.

In arranging certain specimens in the Mineralogical Museum of Zurich, Professor Kenngott discovered a piece of iron marked "native iron from Styria." Suspecting it to be meteoric, he sent it to the Director of the Imperial Museum at Vienna, who had it cut and polished. Subsequent treatment with acids left no doubt of its cosmical origin. It also contains crystals, which appear to be olivine and pyrosene, and its general character seems to identify it with the meteorite which fell many years since at Steinbach, in Saxony. It may be mentioned that no meteorite has yet been known to have fallen in Styria. It would be interesting if the directors of museums would submit any specimens of so-called native iron that they may have in their possession to similar tests.

The hippophagists of Paris, headed by Baron Larrey and Geoffrey de St. Hilaire, have long desired to establish in this city butchers' shops where their favourite meat might be sold, but certain obstacles have hitherto prevented it. There are hopes, however, now that not only shall we have a horse butcher's shop in full operation, but also a horse *restaurant*. How much better you manage these things in England, where, for a few pence, you can obtain, both raw and cooked, sufficient horseflesh to satisfy the most inveterate horse-eater. By the way, what would be the proper English word for horse-meat? According to the rule enunciated by the famous Saxon etymologist, Wamha, it should be *cheval*, or some word derived from it. However, joking apart, I can personally testify that young horse is quite as succulent as young bull, and that old horse is infinitely more palatable and tender than old cow.

The French Society for the Prevention of Cruelty to Animals (Societé Protection des Animaux) goes further than the English institution by not only endeavouring to prevent its *protegés* from being cruelly treated, but by rewarding inventions tending to increase their comfort and well-being. At the last meeting of the Paris society, medals were given for a new form of horse-shoe for use in slippery weather, a saddle which is stated to be more comfortable than the ordinary form, a horse-collar having similar merits, a sieve for cleaning grain from dust and grit, trusses for the cure of hernia in young horses, and an apparatus for the more effectual aeration of the water in fish tanks during transport.

In a letter to M. A. Quetelet, of Brussels, M. Heidinger, of Vienna, who has so thoroughly identified himself with the investigation of meteorites, gives some interesting particulars of the fall of an aerolite at Inly, near Trehizond. It fell in an easterly direction at about three o'clock in the morning on December 10 last, with a terrific explosion, resembling the discharge of hundreds of cannon. Some pieces supposed to belong to it have been forwarded to Vienna, but from the examination already made of them their origin seems to be rather terrestrial than cosmical.

M. Goldschmidt still continues his laborious investigations into the singular variability of the star 40,196 (Lalande). The result of his observations is that it accomplishes its wonderful cycle in a period of 197 days. It remains nearly invisible for 61 days, it then gradually increases in luminosity for 56 days more, remains stationary for a perceptible period, then diminishes for 78 days, and finally disappears.

Father Secchi, of Rome, so well known to your readers by his lunar observations and drawings, has just published a work called "*L'unità delle forze Fisiche*," which, from a cursory glance, promises to be most exhaustive in its character.

Some of my friends here who belong to the fourth estate are full of a new instrument, lately invented by M. Bryois. It is called a "*Sténographe imprimeur mecanique*," and is for the purpose of taking short-hand notes with increased quickness. It consists of a series of levers worked by keys like a piano, and acting on a series of types which impress themselves on a strip of paper which gradually unrols itself. Working only with one finger, an ordinary operator can work as quickly as the best short-hand reporter, but by using two hands the celerity is increased to a surprising degree. Imagine it being stringed and introduced into the gallery of the House of Commons, what brilliant fantasias would be performed when certain members were on their legs—what dreary tunes would be given out when other members were on theirs.

A distinguished member of the London Chemical Society has just informed me that a sub-committee has been formed from amongst the members of the council of that body to decide on the question of doubling certain of the equivalents in accordance with the views of Cannizzaro, Würts, Williamson, and others. Although, of course, the truth or falsity of a theory cannot be settled by act of Parliament, still, the authoritative declaration of the representatives of a learned body would do much to settle the matter and produce that unity of formulæ so much desired by your Hanwell correspondent in his letter in last week's Chemical News.

I see that the Cornish fellow-townsmen of Sir Humphrey Davy are about to erect a monument to his memory in the form of a very ugly obelisk. Would not a scholarship or even a medal to be given annually in connection with the College of Chemistry in the Chemical Society be a more fitting way of expressing our admiration of this great man? I am sure if such an idea were started it would receive the most earnest support from every foreign *savant*, who, although they quarrel amongst themselves on every subject, agree at least upon one—the greatness of our greatest English philosopher.

Properties of Silicates.—New Antidotes.

To the Editor of the Chemical News.

Sir,—Gelatinous silica being known to be soluble in alkaline solutions such as those of caustic soda, it might fairly be presumed that it would also be soluble in an alkaline silicate, although I am not aware of this having been published as a fact.

But the same property could not probably have been anticipated of the silicates of the earths and metals. The silicate of magnesia, for example, in the gelatinous or recently prepared state, is not soluble in a solution of caustic soda, but readily so in a solution of silicate of soda; and the latter rule holds good through all the series of silicates.

The solvent power of the alkaline silicates seems, therefore, to be altogether different in degree and in other important particulars from that of other alkaline solutions. Hence through this property we have soluble glass in as great variety and of tints as various and delicate as we have in stained glass. The soda silicate of cobalt is of a beautiful rose colour—that of chromium green, &c. But the tints of the metallic-coloured silicates are modified by solution in the colourless compound soluble silicates—that of copper, for instance, in a soda silicate of magnesia, is different from that of its solution in silicate of soda.

The above facts will, I think, be sufficient to indicate the importance of a true knowledge of the compound soluble silicates in geology and mineralogy, and lead to a more exact explanation of the colour of a great number of minerals and of many of the precious stones.

The silicic acid of the alkaline silicates again displaces the carbonic acid in carbonates, even at the ordinary temperature, and very rapidly by the aid of heat. This fact will aid towards explaining the formation and composition of many rocks, and be a guide in the production of artificial stones in endless varieties.

As regards agriculture, the ammonio-silicates seem not only to be the most soluble, but also to possess the greatest solvent powers of all the alkaline silicates. When we add to the series the phospho-silicates, also highly soluble, it seems to me that a field of investigation is laid open worthy of the highest science of the day in the department of agricultural chemistry, and which, if followed, is likely to lead to practical results of vast importance, and to a true solution of many things that have not hitherto been satisfactorily explained.

There is still another field open to investigation with these interesting compounds, namely, the use of them as antidotes to poisons.

For this purpose I would suggest the soda silicates of magnesia, alumina, and lime. In case of any poisonous mineral salt being taken, an instantaneous precipitation of an insoluble silicate would occur in the stomach, and probably without the least injurious effect to the coats thereof, by prompt administration of a dilute solution of any of the above-named compound soluble silicates, or of a solution of silicate of soda saturated with gelatinous silica. It is a question which I have commenced investigating, whether the alkaloids may not be rendered insoluble, and therefore inert, through their means.

I am, &c.,
Henry Ellis.

Bangor, June 28.

The Chemical Society.

To the Editor of the Chemical News.

Sir,—In your notice in the last number of the Chemical News of my remarks at a recent meeting of the Chemical Society there is a trifling error. It would appear from the report that I had alluded to nitro-compounds of the hydrides or radicles, when, in fact, my process of separation was founded on their power of resisting fuming nitric acid.

I said that this question of isomerism was attended with the greatest possible difficulties, so much so that it behoved us in the present instance to suspend our judgment.

I also said that among the product of the distillation of Boghead coal were several hydrocarbons, having the composition and vapour densities of the alcoholic radicles, the substance having the composition of butyl, differing, however, from Kolbe's butyl in having a boiling point eleven degrees higher. Like the radicles, the hydrocarbons in question were almost entirely unacted on by fuming nitric acid.

I also called attention to the fact that in my original memoir I had stated that they might be the isomeric hydrides, but that I was unable to find any decided differences between them and the radicles.

I also further stated that I had since found that the lutidine from cinchonine was certainly distinct from the lutidine of bone oil. I did not say anything about the lutidine from Boghead coal. I do not think it has, as yet, been obtained from that substance.

Trusting to your kindness to make the above corrections,
I am, &c. C. G. Williams.

Harrow, July 4.

[We regret that the observations of our esteemed correspondent were delivered in a tone so inaudible that the reference to the origin of the two distinct kinds of lutidine was but imperfectly apprehended. The second paragraph above is practically synonymous with the statement of our reporter, and the opinion of the hydrides being not merely isomeric, but absolutely identical, with the organic radicals was, of course, the main point both of the lecturer's and of our correspondent's remarks.—Ed. *C. N.*]

ANSWERS TO CORRESPONDENTS.

Vol. IX. of the Chemical News, containing a copious Index, is now ready, price 10s. 6d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. X. commenced on July 2, 1864, and will be complete in 26 numbers.

A Reader.—See page 61 of our last volume.

J. W. M. will see his question answered in another part.

M. P. S.—Under consideration.

G. B.—The exact form of the apparatus is of no consequence: what you describe will answer very well.

A Reader.—We cannot give surgical advice, but we may answer your first question in the negative. With regard to the second, an operation is sometimes performed for the purpose which is occasionally successful. Apply to a respectable surgeon.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Motions of Benzoic Acid on the Surface of Water, *by* CHARLES TOMLINSON, *F.C.S.*

IN a shilling volume published in Weale's Rudimentary Series[*] I have traced the history of that remarkable fact—the motions of camphor on water,—which has also been discussed in the pages of the CHEMICAL NEWS.[†] In getting up the history I was so fortunate as to discover a letter written in Latin by the celebrated Volta to his friend Dr. Frank,[‡] which seems to have escaped the notice of subsequent writers, and its very existence was denied by Dutrochet, who, writing on the subject of the camphor motions, remarks that "*Volta n'a rien écrit lui-même sur ce sujet.*" [§]

Referring to the motions of camphor, Volta says:—"I had scarcely made up my mind as to the nature of the phenomena when I was bold enough to predict to you and Brugnatelli that flowers of benzoin, having about the same volatility as camphor, would display similar effects. When this opinion was tested by experiment, I saw, not without pleasure, the glittering, feathery little crystals of benzoin, when thrown on the surface of water, divide, repel each other, and rotate even more perfectly than fragments of camphor. Indeed, this rushing to and fro and the rotatory motion are more striking than in the case of camphor, although the phenomena do not last nearly so long."

I have often repeated this experiment, which requires the same precautions as to chemical purity as in the case of camphor, and also a certain elevation of temperature. Where the experiment fails in cold or damp weather on clean water at the temperature of the air, it will succeed with water raised to 80° or 90°. In dry, warm weather this experiment may be easily performed. Of course, the sublimate itself must be clean; if, while being purchased, it is put into or taken from the scale pan with the fingers by the gentleman who serves it, that slight source of impurity may endanger the result.

But my object in writing this note is to point out a new method of performing the experiment. If a few drops of oil of bitter almonds be exposed to the air in a watch-glass they will, in the course of some hours, solidify into thin crystalline flakes of benzoic acid. One or two of these flakes placed on the surface of clean water in a clean glass will rotate with great vigour, throwing off a visible film, the reaction of which produces the motion. In a shallow glass vessel four inches in diameter the motions last longer than in a vessel of smaller diameter, but when the adhesion of the surface is satisfied by being completely covered with a very thin film, the motions can be renewed by removing the flake of benzoic acid to a clean vessel of water. The flake should be removed on the end of a clean platinum spatula, or some similar tool, and on touching the surface of fresh water with this the fragment will dart off from it and commence a new series of wild gyrations and wide sweeps on the surface, often vibrating rapidly up and down the capillary curve of the water, as if seeking to leap out of the vessel. It will then move rapidly round the circumference, as if seeking an opening by which to escape, and all at once will suddenly stop, throw off one or two small fragments which spin wildly, and disappear, and then renew its eccentric wanderings until the adhesion of the surface is again satisfied. If the fragment be now transferred to another vessel it will resume its antics as before.

Although in these motions there is much that is common to camphor, there is also something belonging to benzoic acid, such as a series of agitated, trembling, zigzag motions, and rapid rotations as if upon a fixed vertical axis. The crystalline flakes are very favourable to this last result, since by lying flat upon the water there is a more perfect adhesion. When the flake has a little of the oil of bitter almonds adhering to it the effect of the spinning motion is very pretty; the oil forms iridescent films, which, by the rapid rotation, are thrown into circles, giving the effect of a brilliant firework on the surface of water.

In the CHEMICAL NEWS, No. 197, I pointed out what I believe to be the true action of oils in arresting the motions of camphor. A fixed oil stops the motions by occupying the surface with a film and preventing adhesion between the camphor and the water; a volatile oil may stop the motion only while it is evaporating, unless it leave behind a permanent resinous or other product which occupies the surface. Or it may not arrest the motions at all if the camphor film have a stronger adhesion to the water than the oil film. In this last case the camphor will sail in and about and through the oil film, as if quite indifferent to its presence. So also an oil that contains oxidised products will stop or prevent the camphor rotations; but if such oil be distilled and a drop be placed on the surface the film will have no such effect.

Now, all this applies more or less to the motions of benzoic acid on water. Oil of bitter almonds, oil of cubebs, and some others have no effect in stopping the motions of the fragments; old essential oils stop them, but if distilled do not do so; the fragments of benzoic acid will skate in and through and about the oil film, cutting it up and driving it about with vigour. Films of turpentine and paraffine oils may be mentioned as examples.

Camphor fragments rotate well on the same surface with benzoic acid. The flakes of the latter are heavier than water, and will sink if allowed to fall on the surface from some height. They remain at the bottom quite inert, but on being brought to the surface again rotate.

A few drops of oil of bitter almonds in a white glass bottle, corked, and put on the window frame will in a few hours form a deposit of benzoic acid on the side nearest the light—that is, on the coldest side.

I may mention an instance of persistence of impressions on the retina in connection with these motions. It has happened several times that on putting out the candle at night, spectra of these motions have occupied the eye for some minutes before going to sleep. The fragments of camphor, benzoin, &c., as well as the lines they describe, appear as *black* on a greyish ground; the motions are rapid, and the effect unpleasant, but entirely within the eye, not projected on a distant ground, as ocular spectra often are.

King's College, London.

PHARMACY, TOXICOLOGY, &c.

The Application of Dialysis to the Investigation of Alkaloids. New Property of Digitaline, by M. L. GRANDEAU.

GRAHAM's admirable researches on molecular diffusion

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[*] "Experiental Essays." Virtue, Brothers. 1863.

[†] Nos. 186, 188, 189, 190, 194, 197.

[‡] *Delectus Opusculorum Medicorum.* Ticini, 1787. Vol. 3rd. A copy of this work is in the library of the College of Surgeons.

[§] *Recherches Physiques sur la Force Epipolique.* Part I. Paris. 1842. Page 6.

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have given to chemical analysis valuable processes for the separation of certain bodies. Toxicology and physiological chemistry especially will profit largely from methods of dialysis.

For some months I have followed up these researches in the medical laboratory of the College of France, and beg permission to submit to the Academy my preliminary results.

Graham has shown that by the aid of dialysis very minute quantities of certain poisons, mixed with various organic matters, may be detected, especially arsenious acid and strychnine; and I have myself already experimented on morphine, brucine, and digitaline.

1. Dialysis of Digitaline.—Place in the dialyser 100 cubic centimetres of distilled water holding in solution 0 gr. 01 of pure digitaline. Suspend the dialysis after twenty-four hours; carefully evaporate to dryness the liquid contained in the outer vase in a weighed platinum capsule. It will leave a residue weighing exactly 0 gr. 01, with a bitter taste, and presenting the characteristics of digitaline, of which more further on.

Evaporate to dryness in a weighed platinum vessel the liquid remaining in the dialyser; it volatilises, leaving no residue, all the digitaline having passed into the dialysed liquid.

2. Dialysis of Urine, containing 1 gr. 01 of Digitaline.—Into 45 cubic centimetres of fresh normal urine pour 2 cubic centimetres of a solution containing 0 gr. 50 of digitaline to 100 centimetres cube of water; after eighteen hours suspend the dialysis and evaporate to dryness the liquid in the outer vessel (about 300 cubic centimetres). Extract the almost colourless residue by alcohol; and the alcoholic solution, evaporated to dryness, shows all the characteristics of digitaline with as much clearness as the residue of two cubic centimetres of the normal solution of digitaline. Evaporate separately the contents of the dialyser, and the residue will be brown; then extract by alcohol of 95°, and the greenish solution thus obtained will give all the reactions indicating the presence of traces of digitaline. The dialysis then was not complete.

3. Dialysis of Morphine, Brucine, and Digitaline Mixed with Animal Matters.—Take the stomach and intestines of a dog (some hours after death), macerate them in water at 25° or 30° for about two hours; filter the yellowish, strongly-smelling liquid through canvas. Divide it into four parts, each of 250 cubic centimetres; to the first add 0 gr. 04 of digitaline; to the second, 0 gr. 02 of brucine; to the third, 0 gr. 02 of hydrochlorate of morphine; leave the fourth intact; dialyse these four liquids separately. After twenty-four hours carefully evaporate the liquids contained in the outer vessels; recover each of the residues by alcohol, to separate the mineral salts (salts of soda, lime, &c.) which have been dialysed. The ordinary reagents of brucine (nitric acid) and of morphine (nitric acid, perchloride of iron) clearly show the presence of these alkaloids in the residues of the alcoholic liquids. Digitaline is found equally in the water of the first vessel. Divide the residue of the evaporation of that portion of the liquid to which no vegetable alkali was added into several parts, and test it with the reagents used to discover brucine, morphine, and digitaline. This experiment is merely intended to show that the animal matters, to which the poisonous substances are added, do not by themselves give, with reagents, colorations which might lead to error. The result of this test leaves no doubt as to the value of dialysis applied to researches of this kind.

In the course of this preliminary study I endeavoured to find some reaction as much as possible characteristic of digitaline. Hitherto we know no reaction for distinguishing digitaline from other vegetable poisons, except the green colour obtained by dissolving this substance in concentrated hydrochloric acid. This reaction, as has been observed, cannot be taken as an unfailing indication of the presence of digitaline, for the same colour is produced by several other organic matters. The successive action of sulphuric acid and bromine vapours have hitherto seemed to characterise even very small quantities of digitaline. Pure digitaline takes a sienna-brown colour on contact with concentrated acid, turning after a time to vinous red, and on the addition of water immediately becoming dirty green. When, instead of operating on, for instance, 1 centigramme of solid digitaline which has not yet been in contact with any liquid, we submit to the action of sulphuric acid the residue of the evaporation of several drops of a diluted solution of digitaline, the colour, instead of brown, is lighter or darker reddish-brown, according to the quantity of material employed. With very small quantities of digitaline (0 gr. 0005, for instance), the colour is rose, like the flower of the digitalis. On exposing digitaline, moistened with sulphuric acid, to bromine vapours, the mixture instantly becomes violet, and the shade varies from heartsease violet to mauve, according as there is present more or less digitaline. The coloration shown by sulphuric acid, and modified by bromine vapours, is most distinct with the residue of the evaporation of 1 centimetre cube of water containing 0 gr. 005 of digitaline; it is also very clear with 0 gr. 0005 of this poisonous substance. It is observable with even the very faintest traces of digitaline. None of the following substances, which I have submitted to the same reaction, has evidenced this property:—Morphine, narcotine, codeine, narceine, strychnine, brucine, atropine, solanine, salicine, santonine, veratine, phlorhidzine, daturine, amygdaline, asparagine, cantharidine, cafeine.

Dialysis—and in this consists its greatest value—allows the separation of the vegetable poisons from the animal substances with which they are mixed, in a state sufficiently pure to enable us to identify them by their principal characteristics.—*Comptes Rendus*, lviii, 1048.

PHYSICAL SCIENCE.

Investigations on the Specific Heat of Solid and Liquid Bodies, by HERMANN KOPP, *Ph.D.*

(Continued from Vol. IX., page 295.)

THE author next discusses whether it is to be assumed that the elements enter into compounds with the atomic heats which they have in the free state. This assumption is only admissible provided it can be proved that the atomic heat of a compound depends simply on its empirical formula, and not on the chemical character or rational constitution. Much of what has previously been said favours this view of the case. It is also supported by the fact that similar chemical character in analogous compounds, and even isomorphism, do not pre-suppose equality in the atomic heats, if in one compound an atomic group (a compound radical) stands in the place of an elementary atom of another; for instance, the atomic heat of cyanogen compounds is considerably greater than those of the corresponding chlorine compounds, and those of ammonium materially greater than those of the corresponding potassium compounds. A further support for that assumption is found in the fact that, regardless of the chemical character, the atomic heat of complex compounds is found to be the sum of the atomic heats of simpler atomic groups, the addition of which gives the formulæ of those more complex compounds. A few cases selected from the comparisons of the author may explain this. The atomic heats have been found,—

For the oxides		$R\Theta$	11·1
For binoxide of tin		$\text{Ꞩ}n\Theta_2$	13·8
Total for		$RR\Theta_3$	24·9
For sesquioxide of iron		$Fe_2\Theta_3$	26·8
or,			
For oxides	$2R\Theta =$	$R_2\Theta_2$	22·2
For binoxide of tin . .	$3\text{Ꞩ}n\Theta_2 =$	$R_3\Theta_6$	41·4
Total for		$R_5\Theta_8$	63·6
For arseniate of lead		$Pb_3As_2\Theta_8$	65·4

Finally, the author shows, as supporting that assumption, that (as was already maintained) water is contained in solid compounds with the atomic heat of ice. The various determinations of the specific heat of ice give the atomic heat of $H_2\Theta$ at 8·6 for temperatures distant from 0°, and at 9·1 to 9·8 at temperatures nearer 0°. The atomic heat has been found (to adduce again a few comparisons)—

For crystallised chloride of calcium	$\text{Ꞓ}aCl_2 + 6H_2\Theta$	75·6	
For anhydrous chlorides .	RCl_2	18·5	
Difference for . .	$6H_2O$	$\frac{57{\cdot}1}{6}$	$= 9{\cdot}5$
For crystallised gypsum .	$\text{Ꞓ}a\text{Ꞩ}\Theta_4 + 2H_2\Theta$	45·8	
For anhydrous sulphates .	$R\text{Ꞩ}\Theta$	26·1	
Difference for . .	$2H_2\Theta$	$\frac{19{\cdot}7}{2}$	$= 9{\cdot}9$

The opinion that the elements enter into compounds with the atomic heats they have in the free state has been already expressed; but the view has also been defended that the atomic heat of an element may differ in a compound from what it is in the free state, and may be different in different compounds. The author comes to the result that the latter view is not proved and is inadmissible.

As the result of all these comparisons and observations, the author arrives at the conclusion:—Each element, in the solid state and at an adequate distance from its melting-point, has one specific or atomic heat, which may indeed somewhat vary with physical conditions, different temperature, or different density, for example, but not so much as to necessitate that being taken into account in considering the relation in which the specific or the atomic heat stands to the atomic weight or composition. For each element it is to be assumed that it has essentially the same specific heat or atomic heat in the free state and in compounds. He then passes on to determine what atomic heats are to be assigned to the individual elements. As data for determining this he takes (1) the atomic heats which follow from determinations of the specific heat of the elements in the free, solid state; (2) the atomic heats obtained for an element, if, from the atomic heat of one of its compounds, which contains beside it only elements of known atomic heat, the atomic heats corresponding to the latter elements are subtracted; (3) the difference found between the atomic heats of analogous compounds of an element of unknown, and of an element of known atomic heat, in which case the difference is taken as being the difference between the atomic heats of these two elements. The author dwells upon the fact that in the indirect deduction of an element by (2) and (3) the result may be uncertain: first, because the atomic heats of compounds are frequently not known with certainty, as is seen by the circumstance that analogous compounds, for which there is every reason to expect equal atomic heat, are found experimentally to exhibit considerable differences; but, secondly, because in such deductions the entire relative uncertainty in the atomic heats for a compound, and for that to be subtracted from its composition, is thrown upon a small number, the residue remaining in the deduction.

The details of the considerations cannot be gone into by which the author deduces the atomic heat of the individual elements; the results simply, which are not all attained with equal certainty, may be adduced. The author adopts the atomic heat 1·8 for Ꞓ, 2·3 for H, 2·7 for B, 3·7 for Ꞩi, 4 for Θ, 5 for Fl, 5·4 for P and Ꞩ, 6·4 for the other elements for which or for whose compounds the atomic heat is known in somewhat more trustworthy manner, it being left undecided in the case of the latter elements, whether (in accordance with Dulong and Petit's law) they have the same atomic heats, or whether the differences in the atomic heats cannot at present be shown with certainty.

The author gives for all compounds, whose specific heat has been investigated in a trustworthy manner, a comparison of the specific heats found experimentally with those calculated on the above assumption. The atomic heat of a compound is obtained by adding the atomic heats of the elements in it, and the specific heat by dividing this atomic heat by the atomic weight. The calculated specific heat of chloride of potassium, KCl, is $\frac{6{\cdot}4+6{\cdot}4}{74{\cdot}6} = 0{\cdot}172$; of sulphide of lead, PbS, $\frac{6{\cdot}4+5{\cdot}4}{239} = 0{\cdot}0494$; of borate of potass, $KB\Theta_2$, it is $\frac{6{\cdot}4+2{\cdot}7+(2\times 4)}{82} = 0{\cdot}209$; of tartaric acid, $\text{Ꞓ}_4H_6\Theta_6$, it is $\frac{(4\times 1{\cdot}8)+(6\times 2{\cdot}3)+6\times 4}{150} = 0{\cdot}300$.

A table, embracing 200 compounds, shows, on the whole, a sufficient agreement between the calculated and the observed specific heats. The author remarks that a closer agreement between calculation and observation cannot be hoped than that between the observed atomic heats of such compounds, for which, from all we know at present, the same atomic heat is to be expected in conformity with Neumann's law, to which, in such cases, of course, calculation corresponds. In only a few cases are differences between calculation and observation met with which exceed these limits, or exceed the deviation between the results of different observers for the same substance.

If calculation of the specific heat does not supersede the necessity of experimental determination in the solid state, and does not give a trustworthy measure for the accuracy of such determinations, it gives a rough control for the experimental determinations, and it indicates sources of error in the experiments, which, without it, would not have been noticed. An instance may be adduced. The author found for sesquichloride of carbon Ꞓ_2Cl_6, which, according to Faraday, melts at 160°, the specific heat, between 20° and 50°, to be 0·276 in one series of experiments, and 0·265 in another. Hence the number 0·27 might from this be taken to express the specific heat of the compound. But calculation gives $\frac{(2\times 1{\cdot}8)+(6\times 6{\cdot}4)}{237} = 0{\cdot}177$, a very different number. A third series of experiments, with substance once more recrystallised, gave for the specific heat between 21° and 49° 0·278, confirming the previous determinations. It might here appear doubtful whether calculation was not refuted by experiment. The discrepancy was removed by the observation that the substance is distinctly more viscous at 50° than it is at lower temperatures, and by the suspicion that it might at 50°, that is, 100° below its melting-point, already absorb some of its latent heat of vitreous fusion. This was found to be the case; two concordant series of experiments gave as the mean of the specific heat the numbers:—

Between 18° and 37° . . .	0·178
Between 18° and 43° . . .	0·194
Between 18° and 50° . . .	0·277

The first two numbers differ so little that it may be supposed the number found for temperatures below 37° is very near the true specific heat of this compound; it also agrees well with the calculated number.

In the sixth part of his paper the author enters into considerations on the nature of the chemical elements.

He calls to mind the discrepancy which has prevailed, and still prevails, in reference to certain bodies, between their actual indecomposibility and the considerations, based on analogy, according to which they were held to be compound. Even after Davy had long proclaimed the elementary nature of chlorine it was maintained that it contained oxygen. In regard both to that substance and to bromine and iodine, the view that they are peroxides of unknown elements still finds defenders. That iodine, by a direct determination of specific heat, and chlorine, by indirect deduction, are found to have an atomic heat in accordance with Dulong and Petit's law puts out of doubt that iodine and chlorine, if compound at all, are not more so than the other elements to which this law is considered to apply.

According to Dulong and Petit's law, compounds of analogous atomic composition have approximately equal atomic heats. In general, compounds whose atom consists of a larger number of undecomposable atoms, or is of more complex constitution, have greater atomic heat. Especially in those compounds all of whose elements follow Dulong and Petit's law is the magnitude of the atomic heat a measure of the complication or of the degree of complication. If Dulong and Petit's law were universally valid, it might be concluded with great certainty that the so-called elements, if they are really compounds of unknown simpler substances, are compounds of the same order. It would be a remarkable result if the art of chemical decomposition had everywhere reached its limits at such bodies, which, if at all compound, have the same degree of composition. Let us imagine the simplest bodies, perhaps as yet unknown to us, the true chemical elements, to form a horizontal layer, and above them to be arranged the more simple and then the more complicated compounds; the general validity of Dulong and Petit's law would include the proof that all the elements at present assumed to be such by chemists lay in the same layer, and that in admitting hydrogen, oxygen, sulphur, chlorine, and the various metals as elements, chemistry has penetrated to the same depth in that range of inquiry, and has found at the same depth the limit to its advance.

But with the proof that this law is not universally true, the conclusion to which this result leads loses its authority. If we start from the elements at present assumed in chemistry, we must admit rather that the magnitude of the atomic heat of a body does not depend on the number of elementary atoms contained in a molecule or in the complication of its composition, but on the atomic heat of the elementary atoms which enter into its composition. It is possible that a decomposable body may have the same atomic heat as an element. Chlorine might certainly be the peroxide of an unknown element which had the atomic heat of hydrogen. The atomic heat of peroxide of hydrogen, $H\Theta$, in the solid state or in solid compounds, must be $= 2·3 + 4 = 6·3$; agreeing very nearly with the atomic heats of iodine, chlorine, and the elements which follow Dulong and Petit's law.

In a very great number of compounds the atomic heat gives more or less accurately a measure for the complication of the composition. And this is also the case with those compounds which, from their chemical deportment, are comparable to the undecomposed bodies. If ammonium or cyanogen had not been decomposed, or could not be by the chemical means at present available, the greater atomic heats of the compounds of these bodies, as compared with analogous potassium or chlorine compounds, and the greater atomic heats of ammonium and cyanogen obtained by indirect determination, as compared with those of potassium and chlorine, would indicate the compound nature of those so-called compound radicals. The conclusion appears legitimate, that for the so-called elements the directly or indirectly determined atomic heats are a measure for the complication of their composition. Carbon and hydrogen, for example, if not themselves actually simple bodies, are yet simpler compounds of unknown elements than silicium or oxygen, and still more complex are the elements which may be considered as following Dulong and Petit's law.

It may appear surprising, and even improbable, that so-called elements, which can replace each other in compounds, as, for instance, hydrogen and the metals, or which enter into isomorphous compounds as corresponding elements, like silicium and tin, should possess unequal atomic heats and unequal complication of composition. But this really is not more surprising than that undecomposable bodies and obviously compound bodies, hydrogen and hyponitric acid, or potassium and ammonium, should, without altering the chemical character of the compound, replace one another, or even be present in isomorphous compounds as corresponding constituents.

The author concludes his memoir with the following words:—"I have here expressed opinions in reference to the nature of the so-called elements, which appear to depend upon allowable conclusions from well-demonstrated principles. It is of the nature of the case that with these opinions the certain basis of the actual and of what can be empirically proved is left. It must also not be forgotten that these conclusions only give some sort of clue as to which of the present undecomposible bodies are of more complicated and which of simpler composition, and nothing as to what the simpler substances are which are contained in the more complicated. Consideration of the atomic heats may declare something as to the structure of a compound atom, but can give no information as to the qualitative nature of the simpler substances used in the construction of the compound atoms. But even if these conclusions are not free from uncertainty and imperfection, they appear to me worthy of attention in a subject which is still so shrouded in darkness as the nature of the undecomposed bodies."

PHOTOGRAPHY.

On the Application of Potassio-Ammonium Chromate to Photography, by E. Kopp.

(Continued from Vol. IX., page 196.)

All the chromic acid is dissolved, and only oxide of chromium remains as residue by prolonged washing simply in water, either pure, alkaline, or even simply calcareous.

For this reason the washing of photographs should not be carried too far. Otherwise the brown image will become paler and paler, until it retains only the light-greenish tint of hydrate of oxide of chromium.

This ready alteration of the compound CrO_2 becomes in this respect a disadvantage, while in other respects it is equally an advantage.

It allows the employment of operations of a very different nature to strengthen the image, and fix it permanently and unalterably.

In fact, with the superoxide there are instantaneously fixed on the paper both chromic acid and oxide of chromium, and each of these two compounds, possessing a colouring power much more intense than that of CrO_2, is capable of entering into new combinations.

1. If it is desired to fix chromic acid we have but to submit the paper with the image, previously washed, to the action of solutions of metallic salts capable of forming insoluble chromates (even in a slightly acid liquid) and highly coloured; such are the chromates of lead, bismuth, silver, mercury, &c.

Thus, to cite but one instance, by shaking the photographs in a very weak but bright and limpid solution of mercurous nitrate, as neutral as possible, the image almost immediately assumes a decided orange-brownish red tint, produced by the formation of mercurous chromate.

With a salt of lead or bismuth the image would be yellow; with a salt of silver, crimson, &c.

But the transformation is not thus limited; the image once fixed in the state of insoluble metallic chromate, it may be washed perfectly, in order to remove all trace of soluble metallic salt from the white parts, and nothing then prevents its undergoing the action of sulphuretted hydrogen, or alkaline sulphides, and the yellow, orange, or reddish-brown tints turned to more or less deep black.

By this manner of operating it is evident that chromic superoxide furnishes the means of fixing on the paper, in quantities proportional to the intensity of the shades, various metallic salts which, once fixed, may be made apparent by various reactions if, in the state of chromate, the image is not of the desired tint.

As reactions accompanied by phenomena of colour are extremely numerous and varied with the proper metals, which are precisely those which become fixed under the above circumstances, it is not unreasonable to suppose that among them some may be practically utilised. To give but one instance,—by plunging the image formed by mercurous chromate into a weak solution of hyposulphite of soda the orange-brown will be observed to turn to black immediately, more or less brownish or greyish, consequent on the formation of black sulphide of mercury.

2. Setting aside chromic acid, now effects may be obtained by operating on the chromic oxide resulting from the alteration of CrO_2.

We have already observed that by leaving the image formed by CrO_2 for a long time in water, especially in calcareous water, all the chromic acid gradually disappears, and only hydrate of oxide of chromium remains on the paper. This result is obtained much more rapidly by washing with a diluted and warm solution of carbonate of soda, ammonia, or any other salt with an alkaline reaction, always finishing by washing in pure water.

But the hydrate of oxide of chromium serves as a mordant, and it follows that on plunging the paper thus modified into a bath containing a colouring matter susceptible of fixation by the mordant of chromium that an image will turn from its original pale green to the tints produced by this mordant.

The colouring matters serving for this purpose being very numerous, such as alizarine, purpurine, Brazil, logwood, fustic, &c., &c., very varied effects can, of course, be produced.

Logwood is especially fit for this purpose.

It is by no means necessary that CrO_2 should be entirely transformed into Cr_2O_3; it suffices to wash it until no undecomposed chromate remains on or in the fibre of the paper. The small quantity of chromic acid remaining combined with the oxide of chromium operates favourably in modifying the tint of the logwood to bluish black. Also, after a certain period of immersion in a bath of logwood recently prepared, and hot, the image becomes very dark bluish black. The white parts even become much coloured after a time, but they are easily restored: After the dyed paper has been washed, it is plunged into a very weak and tepid solution of chloride of lime, where the undyed parts become rapidly white, and the image reappears. The reaction is brought to an end when the desired tint appears; the paper is then washed and dried.

With other colouring matters the operation is conducted in much the same manner, subject to modification according to circumstances and the peculiar nature of the dye. Paper, however close and strong it may be, is, for this kind of preparation, very inconvenient. In prolonged washing in water, especially in hot water, the fibres are raised, and the image loses some of its distinctness; besides, the paper almost always contains some mineral matters, such as alum, chalk, &c., possessing an affinity, more or less marked, for the colouring matter.

These defects are inherent to the nature of ordinary paper, and, to obviate them, it would perhaps be better to use a paper specially prepared; for instance, parchment paper, so that the fibres could not be easily separated, and that they might be free from matters capable of taking the place of mordants.

There is evidently no reason why a more or less fine cloth should not be substituted for paper and operated upon in the same manner. The reactions we have described may be regarded as constituting one of the phases of the application of photography to the production of designs on tissues. Many manipulations difficult, if not impossible, on paper, are perfectly easy on cotton, woollen, or silk materials.

3. The compound CrO_2 fixed on paper and cloth has yet another series of reactions, several of which may be utilised.

They are founded on the property possessed by CrO_2 of acting as a superoxide readily abandoning its oxygen, becoming an oxide, and consequently exercising a strongly oxidising action.

By putting in contact with CrO_2 a body which, while oxidising, forms an insoluble compound, this compound will become fixed at every point where it encounters chromic superoxide.

Among organic compounds there are several which answer this purpose, and which besides assume more or less dark tints, such, for instance, as certain pyrogenic acid, astringent substances, several naphtha and aniline combinations, &c.

They are equally to be found among minerals, and to give but one example we will mention that by plunging a paper coloured by CrO_2 in a weak, cold, and perfectly neutral solution of a ferrous salt (sulphate or chloride) it will after a time be found that oxide of iron is precipitated on all the parts impregnated with chromic superoxide. Oxide of iron may then in its turn serve as a starting point for a whole series of changes of colour, either by a dyeing process or as a consequence of the production of ferrous combinations, presenting their characteristic colorations (Prussian blue among others).

By associating other easily altered salts, such as yellow or red prussiates, with potassio-ammoniacal chromate varied effects may be obtained, and images allowing other kinds of transformations. Thus, for example, a mixture of solution of yellow prussiate, ammonic chloride and potassio-ammonic chromate, with which the paper must be covered or impregnated, gives, after insolation and washing, a yellowish-brown image, which, under the influence of a very neutral and diluted solution of a ferrous salt, gives images of a very agreeable shade, which images may be modified in many ways.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CANTOR LECTURES.

"*On Chemistry Applied to the Arts.*" By Dr. F. Crace Calvert, *F.R.S.*, *F.C.S.*

Gelatine, Glue, Bone-size, Chondrine, their preparation, chemical properties, nutritive value, and application to arts and manufactures. Artificial tortoiseshell. *Isinglass*, its adulterations and adaptations to the clarification of fluids. *Skins* and the art of tanning.

Lecture II.

Delivered on Thursday Evening, April 7, 1864.

As the syllabus will show you, I intend to draw your attention, especially in this lecture, to gelatinous substances, as well as to the art of tanning. There are four distinct gelatinous substances obtained on a commercial scale from animal tissues and bones, viz.,—*Osséine*, which I mentioned in my last lecture, *Gelatine*, *Chondrine*, and *Isinglass*.

Osséine, as already stated, is the animal matter existing in bones, and no doubt it is the same substance which also exists in skins, both during life and when recently removed from the animal. It is characterised by its insolubility, its inability to combine with tannin, and lastly, the facility with which it undergoes a molecular change, and becomes converted into gelatine, slowly, when boiled with water at 212°, rapidly, when boiled under pressure at a higher temperature, and very gradually under the influence of putrefaction.

Gelatine is a solid semi-transparent substance, which absorbs water in large quantities (40 per cent.), becoming thereby transparent. It is very slightly soluble in cold water, but very soluble in boiling water; and this solution has the characteristic property of forming a jelly on cooling. So powerful is gelatine in solidifying water, that one part of gelatine will form a jelly with 100 parts of water. It has been observed that gelatine loses this valuable property if boiled for a long time at ordinary pressure, or if carried to a temperature above 223° F. Before examining the interesting action of acids upon gelatine, allow me to mention that whilst solid gelatine resists putrefaction for a long time, its solutions have a tendency to putrefy rapidly, but I have the pleasure to inform you that a few drops of a substance called carbolic acid will prevent putrefaction for a long period. Gelatine dissolves rapidly in acetic acid, of moderate strength, or vinegar, and this solution, which is used as glue, has the useful property of remaining fluid and sound for some time. But a Frenchman, named Demoulin, has introduced of late years in Paris a solution of glue which is superior to the above and to that in common use, because it does away with the trouble of constantly heating the glue-pot. His process consists in melting one pound of best glue in one pound of water, and adding gradually to the two one ounce of nitric acid of sp. gr. 1·36, heating the whole for a short time, when the fluid glue is prepared. The action of concentrated nitric acid on gelatine is most violent, giving rise to several compounds, amongst which may be cited oxalic acid. The action of sulphuric acid on gelatine is important in a scientific point of view, as an alkaloid called leucine is produced, as well as a sweet substance, called glycocolle, or sugar of gelatine. Gelatine is distinguished from other organic substances by the following chemical reactions:—it gives a white precipitate with alcohol, also with chlorine, none with gallic acid, but one with tannin, or tannic acid. The properties of this precipitate are most important to us, as it is on the formation of it in hides that we ascribe their conversion into leather. The relative proportion of these two substances (gelatine and tannin) in the precipitate varies with the respective proportions brought in contact, but precipitates containing as much as 46 per cent. of tannin have been examined. It is insoluble in water, and presents the invaluable character of not entering into putrefaction. Beautiful fancy ornaments have recently been introduced in Paris by M. Pinson, called artificial tortoiseshell, which he obtains by melting, at a moderate temperature, gelatine with a small amount of metallic salts, running the whole into moulds, staining the mass with hydro-sulphate of ammonia, so as to produce an imitation of the grain of tortoiseshell. The objects so produced are then polished and ready for sale. Before entering on the manufacture of various qualities of gelatine, I should wish to state that there can be no doubt, from the researches of Magendie, as well as from the Report of the Commission appointed by the Netherlands Academy of Sciences, that gelatine as food possesses no nutritive value whatever. Allow me now to give you a rapid outline of the methods followed in the manufacture of various qualities of gelatine. The first quality of gelatine is prepared by taking the clippings, scrapings, and fleshings from the tanyard, treating them with lime water or alkali, to remove any smell and certain impurities. They are then well washed and left in contact for a day or two with a solution of sulphurous acid. They are then placed in a suitable apparatus with water, and heated, when the osséine is converted into gelatine. This is run into a second vessel, and a little alum added, to throw down any impurities that may be in suspension. The liquor is now ready to be run into another pan, where it is concentrated to the necessary consistency, so as to become solid when it is run into wooden moulds. Eighteen hours afterwards the gelatine is turned out of these moulds on to a wet slab, where it is cut into slices by means of a copper wire; these slices are placed on wire gauze frames, and left in a drying shed until they are perfectly dry and ready for the requirements of trade. The second quality of gelatine is prepared by placing bones in large cylinders, and allowing high-pressure steam to arrive at the bottom of the cylinder, which rapidly converts the osséine of the bones into gelatine, and the removal of this is facilitated by allowing a stream of hot water to enter the upper part of the cylinder. The solution of gelatine thus obtained is evaporated, and is usually employed for the preparation of glue. A third quality is prepared by treating bones with hydrochloric acid (as referred to in my first lecture), and submitting the osséine thus obtained to the action of steam. Lastly, a fourth quality of gelatine, called bone-size, is manufactured by boiling more or less decayed bones, as imported from South America and elsewhere, the flesh of dead animals, &c., and concentrating the solution to the consistency required for the various applications it receives in commerce. [The lecturer then described the mode of obtaining the beautiful thin coloured sheets of gelatine used in photography and other fancy purposes, and also the characteristics which distinguished good from bad glues.]

Chondrine, or cartilage gelatine, first noticed by Messrs.

Müller and Vögel, jun., is interesting as possessing qualities, not only different from those of gelatine, but such as injure the quality of the latter when mixed with it. In fact, it gives precipitates with acetic acid, alum, persulphate of iron, and other salts; and as gelatine is often used in connexion with these substances, it is easy to foresee how these precipitates may interfere with its application. On the other hand, the quality possessed by this peculiar gelatine, may, I think, render it serviceable in the art of calico printing, for fixing colours, or as a substitute for albumen or lactarine. Thus, the solution of chondrine and acetic acid may be mixed with any of the new tar colours, and the whole printed, allowed to dry, and steamed; the acetic acid will be driven off, leaving the colour fixed by the chondrine on the fabric. Chondrine is prepared by submitting to the action of heat and water the cartilaginous tissue of animals or the bones of young animals.

Isinglass is obtained from the air-bag or swimming-bladder of several kinds of fish, especially those of the sturgeon tribe, and, although imported from various parts of the world, the principal supplies are from Russia, from whence the best qualities come, which bear the names of Beluga, Volga, or Caspian Sea leaf. Brazil, New York, the East Indies, and Hudson's Bay, also supply various qualities of this valuable substance. It also reaches this country in different states—viz., in leaf and in honeycomb, that is, the bag is cut open, cleaned and dried; and the quality called snow-bleached is enhanced in value by having been buried in the snow on the banks of the Volga for a long period, by which the isinglass is whitened. Pipes, purses, and lumps are bags which have been cleared but not opened; and a quality called ribbons is made by rolling the bag and cutting it into strips before shipping it to this country.

I shall now endeavour to explain to you how the beautiful preparations before you, for which I am indebted to the kindness of Mr. James Vickers, are obtained. The leaf bladder is first softened in water, and rolled out, under high pressure, into thin leaves, which may extend to several feet long; these in their turn are drawn under a number of revolving knives, making 1000 revolutions per minute, by which 6000 of the well-known fine threads are produced in every minute. This quality is chiefly used for culinary purposes. For commercial uses the purses or lumps above mentioned are chiefly employed. These are soaked in water for two or three days, cut open, certain useless parts removed, further softened, rolled, and cut into various dimensions, according to the requirements of trade, their chief use being the clarification of beer and other alcoholic fluids, for which gelatine cannot be employed, because it dissolves in water, whilst isinglass merely swells. The result is that the highly-swollen and extended mass, when poured into beer, wine, or other alcoholic fluids, is on the one hand contracted by their alcohol, and on the other hand it combines with their tannin, forming an insoluble precipitate, which, as it falls through the liquor, carries with it the impurities in suspension, and thus clarifies the fluid. As isinglass is very slow in swelling out in water, brewers employ an acid fluid for the purpose, but, strange to say, instead of using pure acetic acid, many of them take sour beer, and thus run the great risk of spoiling their sound beer. I have known instances of great losses occurring in this way, acetous fermentation having been thus spread through an entire brewery during the summer months. As a large quantity of gelatine, cut into shreds, in imitation of isinglass, is sold at the present day, it may be useful to know that detection is very easy by the following method:—Place a small quantity in hot water, in which gelatine will readily dissolve, whilst isinglass will do so very slowly. I cannot conclude the examination of this interesting class of substances without drawing your attention to the fact that osséine, gelatine, chondrine, and isinglass present marked differences in their textures and general properties, although their chemical compositions may be considered identical, thus:—

	Osséine.	Gelatine.	Chrondrine.	Isinglass.
Carbon .	50·4	50·0	50·61	50·56
Hydrogen .	6·5	6·5	6.58	6·90
Nitrogen .	16·9	17·5	15·44	17·79
Oxygen .	26·2	26·0	27·37	24·75

Esculent Nests.—I must not omit to mention, in connection with this interesting class of substances, these curious gelatinous products, which are not only considered great delicacies in China, India, but even in Europe, where they realise from £3 to £7 per pound; considerable quantities are imported into England. It has long been a disputed question what is the chemical nature of the substance composing these nests, which are the product of a peculiar kind of swallow; but Mr. Payen, by his recent researches, has left no doubt in the minds of chemists that it is an animal, not a vegetable matter. In fact, it is a peculiar mucous substance, secreted by the bird, and composed of carbon, hydrogen, oxygen, nitrogen, and sulphur. Further, it is insoluble in cold water, but soluble in boiling, and differs from gelatine and isinglass in that it does not gelatinise as it cools.

Skins.—Skin consists of two principal parts, one a mere film, called the epidermis, and the other constituting the bulk of the skin, and called the dermis. There are also found in skin a large quantity of blood-vessels, and a small quantity of pigment cells, which hold the colouring matter. Further, the skin contains a small amount of nerves and a number of glands, among which may be cited the sebaceous glands or follicles, which are intended to secrete the unctuous matter constantly accumulating upon the skin, and keeping it soft and pliable; then there are the perspiratory glands, which play a most important part in the physiological construction of the skin. These are so numerous that Mr. Erasmus Wilson has calculated that there are 3528 of them in a single square inch of human skin, so that in an ordinary sized body there are no less than 2,300,000 of these pores. But still the most important part of the hide for us is that called the "dermis." The skins of animals are commercially divided into three distinct classes. The hide is the name given to the skin of full-grown animals, such as oxen, horses, and buffaloes; and these are further sub-divided into fresh hides, that is to say, those which are obtained from animals slaughtered in this country; dry hides, that is, hides which have been dried in the sun, and which are principally imported from South America; dry salted hides, principally from the Brazils, where they are salted and then dried in the sun; and salted hides, which are preserved in Monte Video and Buenos Ayres by salting them, and which are shipped, embedded in salt, to this country. The composition of a fresh hide may be considered to be as follows:—

Real skin	32·53
Albumen	1·54
Animal matters soluble in alcohol .	0·83
Animal matters soluble in cold water	7·60
Water	57·50
	100·00

A second class of hides is that called kips, which are skins flayed from the same kinds of animal as the foregoing, only when young. Thirdly, the term skin is applied to those of small animals, such as the sheep, goat, seal, &c.

I will now endeavour to give you an idea of the preparation which hides undergo to fit them for the art of tanning. These operations are four. The first consists in washing off the dirt from the hide, softening it, if a dried one, or removing the salt, if salted. The second has for its object the removal of the hair, which is effected by two or three different methods. The most usual plan is to place the hides in large vats, containing a weak milk of lime, for two or three weeks, care being taken to remove and replace them every other day, after which time the hair is sufficiently loosened to be removed. A second plan consists in piling up the hides, allowing them to enter slightly into a state of putrefaction, and then placing them in weak milk of lime, so as to complete not only the loosening of the hair, but also the swelling of the hide, for lime also possesses that property. Another process, which is called the American plan, is to hang the hides in pits for two or three weeks, keeping them at a temperature of 60°, and constantly wet, when the hair can be easily removed. Weak alkalies are sometimes substituted with great advantage for lime in the above processes, and this plan is certainly the best, as it does not leave in the hide any mineral residue, as is the case with lime, either in the form of an insoluble soap of lime or of carbonate, both of which are highly objectionable in the subsequent process of tanning, as they act on the tannic acid of the tan, facilitating its oxidation, and thereby rendering it useless. Depilation of hides is sometimes effected by the employment of weak organic acids; thus, the Calmuck Tartars have used from time immemorial sour milk for that purpose. In some parts of France, Belgium, and Germany, the unhairing of the skins is also effected by an acid fluid, produced by the fermentation of barley meal, which gives rise to acetic and lactic acids. To carry out this process, generally speaking, five vats are used. In the first the hides are cleaned; in the second they are softened, and the hair and epidermis prepared for depilation; and the third, fourth, and fifth are used to swell and give body to the hide. This operation, which is called white-dressing, does not work so well as lime for heavy hides, as it swells them to such an extent as to render them unfit to prepare compact leather. When the hair can be easily pulled off, the hides are placed on a convex board, called a beam, and scraped with a double-handed concave knife, which not only removes the hair, but a large amount of fatty lime-soap and other impurities from the hides. The third operation consists in fleshing the hides, by shaving off all useless flesh, fat, and other matter by means of a sharp tool. The fourth operation is called swelling or raising the hide, the purpose of which is the following:—First, the removal of any lime or alkali which may remain in the hide; and secondly, to swell or open the pores of the hide, so as to render them better adapted to absorb the tannic acid of the tanning liquors. This is effected by dipping the hides in weak spent tanning liquors, or liquors which have lost the tannic acid, but which contain more or less of gallic acid, for not only do all tanning matters contain gallic acid, but its proportion is greatly increased during the operation of tanning, by a process of fermentation which goes on during that operation, and which converts tannic acid into gallic acid and a peculiar sugar.

The Tanning of Hides.—The old process of tanning consisted in placing layers of wet tan and of hides alternately, and after two or three months removing the whole from the pit and replacing the old by fresh tan. These operations were repeated until the hides were tanned, which took from eighteen months to two years, owing to the difficulty of the tannic acid reaching the interior of the hide. Of late years the process of tanning has been greatly shortened by treating the bark with water, and steeping the hides in the liquor, first weak and afterwards strong. By this means good leather can be obtained in the space of eight or ten months. More rapid tanning, but probably giving inferior leather, is effected by employing, in conjunction with, or as a substitute for, bark, a decoction of dividivi, valonia, myrobalan, catechu or terra japonica, gambir, &c. Many efforts have been made of late years to apply the laws of hydraulics, as well as several physical and physiological principles discovered by eminent philosophers, with the view of shortening the period of tanning, but as I believe that none of them have received the general sanction of the trade, I shall confine myself to giving you an idea of the most successful ones. The first attempt to acclerate the process of tanning consisted in forcing the tanning fluids into the substance of the hide by means of hydraulic pressure. Mr. Spilbury, in 1831, employed a process which consisted in making the hides into sacks, and plunging them into a tanning liquor; and as the fluid percolated through the skin into the interior of the bag the air was allowed to escape. By this means a certain amount of time was saved in bringing the tanning liquor in contact with the various parts of the skin. Mr. Drake soon followed in the same direction; his plan being to sew hides together, forming bags, which he filled with a solution of tan; and to prevent the distention of the skins by the pressure of the liquid within; they were supported in suitable frames; as the pores became gradually filled with tannin, artificial heat was applied to increase the percolation of the fluid. Messrs. Chaplin and Cox's process is also very similar to the above, the difference being that the tannin fluid is placed in a reservoir, and allowed to flow into the bag of hides through a pipe, the fluid being thus employed at pressures varying according to the height of the reservoir. The bag of hides is at the same time plunged into a solution of tannin to prevent excessive distention. Messrs. Knowles and Dewsbury have recourse to another principle to compel the percolation of the tanning liquor through the hide. To effect their purpose they cover vessels with hides, so as to form air-tight enclosures, and, having placed the tanning fluid they employ on the hides, the vessels are exhausted of air, and atmospheric pressure then forces the fluid through the skins into the vessels below. Mr. Turnbull's process, being an imitation of that used for tanning Morocco leather, need not be described. Attempts have been made from time to time to mineralise hides, that is to say, to substitute for tanning, mineral salts, as will be described in my next lecture, when speaking of the art of tawing skins. The processes which have attracted most notice in this branch of the art of preparing leather are those of Messrs. D'Arcet and Ashton, M. Bordier, and M. Cavalier. M. Bordier's plan is that of dipping hides in a solution of sesquisulphate of iron, when the animal matters of the hide gradually combine with a basic sesquisulphate of iron, rendering the hide imputrescible, and converting it into leather. M. Cavalier's method is to dip hides first into a solution of protosulphate of iron, and then into one containing alum and bichromate of potash. A chemical action ensues, by which the protosulphate of iron is converted into a persulphate, combining with the animal matter, and by its preservative action, together with that of some of the alum, the hide is converted into leather. I think, however, that I shall be able to satisfy you, from the results of many examinations of leather and hides which I have made, that there are good and sufficient reasons why most of these processes have necessarily failed. Inventors have been led to believe, by the statements of many eminent physiologists (as can be proved by reading some of the most recent works on that science), that skin is composed of blood-vessels, glands, &c., plus gelatine, and that if by any mechanical contrivance the tanning liquor could be brought into contact with this gelatine, the leather would be tanned; and many ingenious schemes have been devised, and much money expended, to obtain that result. The fact, however, is that there is no gelatine in skin, for if there were, when hides were placed in water, the gelatine would be dissolved and washed away. But what is supposed to be gelatine in the hides is in reality the isomeric substance called osseine, or one greatly resembling it. The great discovery to be made in the art of tanning, therefore, is that of a chemical or fermentative process, by which the isomeric change (that of the osseine into gelatine) may be rapidly produced, instead of by the slow putrefactive process which occurs in the old method of tanning. Further, I would observe that to convert a hide into leather it is not sufficient that the whole of its animal matter be combined with tannin, for the leather thus obtained would present two great defects: 1st, the hide would not have increased in weight, and the tanner's profits, therefore, would suffer; 2ndly, the leather would be so porous as to be useless for many of the purposes for which leather is required. The reason of this is, that when, after a period of several months, the osséine has been converted into gelatine, and this has become thoroughly combined with tannin, a second series of reactions is necessary to render the leather more solid and less permeable to water, and to increase materially its weight. These reactions constitute what is called feeding the hide, and are brought about by leaving it to steep in more concentrated tanning liquor for a considerable period; and this necessary process, beneficial to the wearer as well as to the producer, appears to me to be that which offers the greatest impediment in the way of shortening the period of tanning. The hides as they leave the tanning yet require several operations before they are ready to be used for soles, or to be curried for various commercial purposes. They are first slightly washed and placed in a shed to partially dry, and are then rubbed with a brush and rough stone on the face of the leather, or hair side, to remove any loose tanning material that may remain on the surface; but this rubbing is not applied to the back, as buyers attach great importance to the peculiar appearance called the bloom, which enables them to judge of the goodness of the tanning. The tanned hides are again slightly dried, and oiled on the face, and then submitted to the pressure of a roller passed over the surface, which has the effect of rendering the leather more flexible, and the surface perfectly uniform. These operations are repeated two or three times, when the leather is ready for soles. Before the tanned hides intended for shoe-soles are considered fit for that purpose, they must be slightly compressed and softened, so as to again diminish their permeability to water. This was formerly effected by beating with a hammer called the mace, but of late years this slow process has been superseded by compressing machines; and I believe those most appreciated in the trade were invented by Messrs. Cox and Welsh, and Messrs. Iran and Schloss.

CHEMICAL SOCIETY.

Thursday, June 30.

Professor A. W. Williamson, Ph.D., F.R.S., *President, in the Chair.*

The minutes of the previous meeting having been read and confirmed, and the several donations to the library announced, the President informed the meeting that he had just received a letter of apology from Mr. Way, accompanied by a medical certificate, according to which he was sorry to have to announce the serious indisposition and consequent absence of the lecturer. Mr. Way had, however, kindly sent forward the notes of his subject, and had deputed Mr. Evans to address the Society in his stead; and he would, therefore, at once call upon Mr. Evans to favour them with the written communication.

The author commenced by referring to a sweeping condemnation of British agriculture and the waste of fertilising material pronounced by Baron Liebig, and promulgated a short time since through the medium of the *Daily Telegraph* and the *Agricultural Gazette*. In the number for November 15, 1862, of the last-named journal appeared a quotation, which was read to the meeting. It warned the British farmer against relying upon the foreign and artificial sources of manure which this country has secured to itself in guano and other native phosphatic materials, and pointed out the necessity of restoring to the soil those mineral ingredients of which it is constantly being robbed by the growth and removal of crops. The modern system of town drainage was that, of course, which came more particularly under Liebig's censure, and the exhaustion of the guano beds had been dwelt upon as a contingency not altogether remote. Some of these assertions had been met in a work entitled "The National Laws of Husbandry, 1863," and the author proposed to deal with these and other points in "The Philosophy of British Agriculture." It had usually been considered necessary that the ingredients of the soil should be rendered soluble before they could be assimilated by the roots of the plant; but Liebig, on the other hand, maintained that this need not always be the case, that even solid substances had the power of entering the vegetable organisms by endosmosis; and, further, he believed that nearly all the carbon was taken in through the roots, and hence he insisted on the decomposition of humus as affording direct nutriment to the plant, whilst the advantage of employing nitrogenous compounds to furnish ammonia was equally problematical. About the year 1850, Mr. Way made some experiments which resulted in the discovery that arable soils had the power of absorbing ammonia, and even of fixing phosphoric acid and the salts of potash. By causing an aqueous solution of sulphate of ammonia to percolate through clay and sandy soils, it was found that the lime contained therein combined with the sulphuric acid and liberated ammonia, which then was retained by the soil, and if a solution of phosphate of soda was passed through a stratum of clay, both the acid and basic constituents became fixed by the earthy matters of the soil. It appeared probable that a class of double silicates was formed similar in constitution to the alums, but which were but sparingly soluble in water. The existence of silicate of ammonia had been denied by Liebig, but it was a fact, nevertheless, that some sort of combination was possible, for both sand and clay absorbed large quantities of ammonia gas, and when soluble ammoniacal salts were brought into contact with the silicates of alumina and lime (or soda) a portion of the ammonia became fixed by these felspathic minerals, and soluble compounds of lime passed through. In this way a large series of double silicates had been formed containing always silicate of alumina in union with a silicate of lime, magnesia, potash, soda, or ammonia. These compounds being then slowly acted upon by water presented to the roots of the plant a ready formed combination of various bases such as they required for successful development. The author admitted a clerical error in the table accompanying his paper of 1850 which had been pointed out by Liebig, but he felt much satisfaction in finding that the eminent German chemist had afterwards, in his "Theory and Practice," published in August, 1853, given him (Mr. Way) credit for having first called attention to the power possessed by clay in absorbing ammonia. This action Liebig considered perfectly analogous to that of carbon in condensing ammonia vapours, and in depriving vegetable substances of their colour and odour. Again, it appeared that the earthy bases in clay removed the nitric acid from saltpetre, the potash then forming a kind of double silicate. Every farmer knows how difficult it is to affect the sub-soil by a top dressing of manure, and hence the practice of growing cereals and deep-rooted plants, such as clover, in series, so that the land may not become unduly exhausted. The accusation made by Liebig to the effect that the British farmers were injudiciously growing more produce on the land than was warranted by the return of the mineral constituents in the shape of manure, was, in the author's opinion, fully and satisfactorily answered by a comparison of the state of agriculture at the present day with that of fifty years ago, and during the latter part of this interval much valuable fertilising matter had been lost by sewage. According to the data collected by the Rugby Sewage Commission, it had been estimated that every individual caused the loss of fifteen pounds of ammonia per annum, and reckoning the cost of this with proportionate quantities of phosphoric acid and potash at ten shillings per individual per annum, it appeared that, with our present population, the country suffered a default by sewage at the rate of five millions sterling. Against this large expenditure, the author estimated the value of imported manures (guano and bone phosphate) at three millions per annum, leaving a deficit of other two millions. In conclusion, the author referred to the discussion pending between Baron Liebig and Messrs. Lawes and Gilbert in reference to the so-called "mineral theory," the first of these authorities maintaining that it was only necessary to restore to the land the ashes of the plants raised thereon; whilst, on the other hand, the English chemists advocated the liberal use of ammonia or of guano manures containing large quantities of nitrogen. It seemed to be almost a matter of indifference whether the hydrogen or oxygen compounds of nitrogen were thus employed; in other words, the nitrates were equally fertilising with ammonia. The author could not help remarking that Liebig had recently changed his opinions respecting the advantages of ammonia; this base could not properly be included amongst the *mineral* constituents of the soil, which were at one time said to be all important, but now that its use had become so general, the great German chemist wished it to be ranked by the side of potash and soda, and maintained that in an agricultural sense "ammonia is a mineral."

The PRESIDENT proposed a vote of thanks to the author for the elaborate paper with which he had favoured the Society; and to Mr. Evans for acting as the mouthpiece on this occasion. He felt sure that the members would participate in expressing their regret at the unavoidable absence through illness of Mr. Way. The subject was one of great interest to many of the Fellows then present, and he trusted the several points would be fully discussed.

Mr. Alderman MECHI bore testimony to the interest and importance of the scientific matters brought forward by Mr. Way. He was himself a firm believer in the advantages to be derived from manurial irrigation. It must be remembered that our present system of house drainage is a comparatively recent invention, not more than twenty years old, and that forty years ago all the excreta of London was carried by barges as far as 150 miles along the coast for the benefit of the farmer. Every agriculturist well knows that if he takes crops off the land for two or three years in succession he cannot maintain the fertility of the soil without restoring the constituents which have been removed. The great question is, therefore, "How is it to be done?" If three millions of sheep were feeding on pasture and were not allowed to manure on the land, every one would say, what a great folly! The speaker had himself sent up to the London market ten acres' yield of peas, but they would not go far towards supplying London's want; in twenty-four hours all and many more would be consumed. It had, indeed, been estimated that 6,000,000 of acres were required to be cultivated in order to supply food for London alone. The rate of exhaustion of the land must then be very great, and so little manurial refuse is returned from the metropolis, that the farmer has to go abroad for his supply of manure to compensate him for this tremendous waste. A Committee of the House of Commons was now inquiring into some of these matters, and it has been calculated that ten inches of rain, or half a year's fall, in Essex, weighing 1000 tons, might be raised 300 feet for an expense of thirteen or fourteen shillings. These facts were promising, but Liebig objected to irrigation and land drainage, because the action of the water was supposed to remove the soluble salts. Mr. Way had, on the other hand, brought forward facts to prove that this was not the case, and the speaker strongly advocated the importance of directing capital to the great desideratum—viz., that of distributing, in the cheapest possible manner, the sewage waters of London over the cultivated lands of Essex and other counties in the neighbourhood of the metropolis. Now that 1000*l.* per yard was being expended upon railways, it must surely be worth while considering the policy of paying at the rate even of 30*l.* per yard for taking sewage into the country. A fall of five feet in the mile was sufficient in the case of the Loch Katrine water supply to Glasgow, and their works extended forty miles.

The remarks offered by Dr. Voelcher and Dr. Gilbert will be reported in our next. The President then adjourned the meeting until after the recess.

LECTURES ON CHEMICAL PHILOSOPHY.—I.

Delivered at the College of France, by M. A. WURTZ.

(Continued from page 8.)

It is proper to say that Gerhardt changed the opinions he before held when he adopted typical formulæ. Up to that time he had considered as scientific only the crude formulæ: a chemical compound he had regarded as a *whole*, in which the elements were combined one with another without any particular arrangement. Hence came originally the name *unitary system* which was given to his doctrine. For example, he represented acetic acid as $C_2H_4O_2$, and alcohol as C_2H_6O, and he explained the formation of acetic ether as the union of these two bodies with the elimination of water.

Such was the way in which he at first interpreted chemical facts: it contrasts singularly with his second method, as we shall see without difficulty. The second method rests on a far more complete view of the phenomena, and a much more natural apprehension of the laws of chemistry. Compare the crude formula by which the formation of acetic ether was explained—a formula which explains nothing—with the typical formula, as under,—

$$\left.\begin{matrix}C_2H_3O\\H\end{matrix}\right\}O+\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O=\left.\begin{matrix}C_2H_5\\C_2H_3O\end{matrix}\right\}O+\left.\begin{matrix}H\\H\end{matrix}\right\}O$$

And it will be seen that this second expression, so much clearer and more true, shows that the metamorphosis in this case is really a double decomposition.

The same views adapt themselves without difficulty to mineral chemistry. Thus, in the formation of nitrate of potash by nitric acid and potash, there is no molecular addition, but a double decomposition, as is shown by the following equation:—

$$\left.\begin{matrix}NO_2\\H\end{matrix}\right\}O+\left.\begin{matrix}K\\H\end{matrix}\right\}O=\left.\begin{matrix}NO_2\\K\end{matrix}\right\}O+\left.\begin{matrix}H\\H\end{matrix}\right\}O \text{ [*]}$$

Here it is seen that nitrate of potash is formed in consequence of a double decomposition. According to Gerhardt, all salts are formed in a similar way; but this, as is easily proved, is an exaggeration.

We see now that the differences between the dualistic and the new theory are most clearly seen in the different ways in which they regard the constitution of salts. Dualism represents these as containing the elements of an anhydrous acid in juxta-position with those of an anhydrous oxide, and this view seems to be supported by the decomposition which they undergo under the influence of the galvanic battery. It is said, for example, that sulphate of soda decomposes into sulphuric acid and soda, but it is not so.

We know that sulphate of copper, when submitted to the current, decomposes into copper and SO_4.

$$CuOSO_3 = Cu + SO_4.$$

The decomposition of sulphate of soda, which the dualist quotes in support of his views, is exactly analogous—SO_3,NaO decomposes into SO_4 and Na. (The proof of this is the fact that when mercury is placed at the electrode, an amalgam is obtained.) Afterwards, and by virtue of a secondary action, Na decomposes some water, and forms NaO; at the same time SO_4 splits up into SO_3, which appropriates the elements of water, and O which escapes. There is, then, a double and not a simple decomposition, and the formula SO_4Na better represents the facts of the electrolysis of sulphate of soda than the formula SO_3NaO.

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[*] It is hardly necessary to point out that in these lectures the author adopts the equivalents C = 12, O = 16, &c. We have not thought it necessary to indicate this by any change of type, since the context will sufficiently show the fact.

But, the dualists will say, the proof that a salt may be composed of an acid and a base,—the proof of dualism—is to be found in the fact that the vapours of anhydrous sulphuric acid, SO_3, in passing over baryta, BaO, heated to redness, will produce sulphate of baryta, SO_3BaO.

Gentlemen, these syntheses prove nothing concerning the constitution of compound bodies.

We can produce sulphate of lead by combining the binoxide, PbO_2, with sulphurous acid, SO_2. Shall we argue from that that sulphate of lead, SO_4Pb, contains $SO_2 + PbO_2$? Not at all.

Berthelot has produced formic acid by the synthesis of carbonic oxide and water. Shall we contend that formic acid contains carbonic oxide and water?

Carius has formed glycol, $C_2H_6O_2$, by combining olefiant gas, C_2H_4, with oxygenated water, H_2O_2; but no one has ever pretended that it would be correct to represent glycol as a binary compound of oxygenated water and ethylene.

Again, Carius has obtained chlorhydric ethalenic ether by the synthesis of ethylene C_2H_4 and hypochlorous acid gas $HClO$. On the other hand, I have formed the same compound by uniting oxide of ethylene with hydrochloric acid. We have thus for chlorhydric-ethelenic ether, the two dualistic formulæ—

$$(C_2H_4 + HClO) \text{ and } (C_2H_4O + HCl).$$

Which is correct?

These facts demonstrate that synthesis does not permit us to pronounce upon the atomic grouping of a compound. Although sulphate of barium is formed by the addition of the elements of sulphuric acid to the elements of oxide of barium, let us guard against drawing the conclusion that sulphate of barium contains ready formed and juxtaposed the elements of $SO_3 + BaO$.

This manner of representing its constitution is an hypothesis and nothing more. An ingenious and convenient hypothesis certainly, and one which has rendered great service to science; but still only an hypothesis, and not a demonstrated truth.

Berzelius has said that the use of an hypothesis begets a belief in its truth, hides its weak sides, and prevents the mind from appreciating adverse facts—a profound observation which seems to me to be especially applicable to the dualistic notions held by the illustrious Swedish chemist.

ACADEMY OF SCIENCES.

July 6.

M. BECQUEREL presented a memoir "*On the Preservation of Iron and Copper in the Sea.*" The author has borrowed from Davy the idea of protecting the metallic covering of ships by disposing bands of another metal (zinc) or an alloy around the vessel.

M. Pelouze contributed a short paper "*On the Saponification of Fatty Bodies by Alkaline Sulphides.*" Monosulphide of sodium the author found to completely saponify olive oil in the cold in about six days. He suggests that this, or a sulphide obtained by reducing sulphate of soda with charcoal, may be used industrially, and thinks that the low cost of this salt in comparison with caustic soda will allow of a little extra trouble to remove any disagreeable sulphur compounds from the soap.

Apropos to this paper, M. Chevruel made some remarks on saponification and the neutrality of salts.

M. Hétet presented a paper "*On the Chemistry of Cotyledon Umbilicus,*" in which he states he has detected the presence of trimethylamine.

M. Hugo Schiff read a paper "*On some Phenic Derivatives of the Aldehydes.*"

A note by M. Debray "*On the Production of some Crystallised Arseniates and Phosphates*" gives an interesting account of a method of obtaining crystals from the amorphous gelatinous precipitates of these compounds. The amorphous precipitates produced by soluble phosphates in metallic solutions are not absolutely insoluble in the liquor in which they are found. If, then, by lowering the temperature the solubility is diminished, a part crystallises on the sides of the glass. When the temperature is raised again more of the gelatinous precipitate is dissolved; and thus by alternately heating and cooling the liquor, the whole of the precipitate may be obtained in crystals—in some instances of considerable size. In this way M. Debray has made a number of double phosphates.

M. Deville announced that he had obtained crystals of chloride of silver by sealing it in a tube with dilute hydrochloric acid, and leaving the tube exposed to a variable temperature for two years.

M. Bechamp described a "*New Mode of Purifying the Heavy Oils from Tar, and a New Hydrocarbon from Coal Tar.*" The author finds that bichloride of tin will separate the bases of coal tar, and so allow a larger quantity of benzine to be distilled. The new hydrocarbon boils from 139° to 140°. M. Bechamp gives no further description at present.

M. Lorin announced that he had obtained *formamide* by the distillation of formiate of ammonia.

NOTICES OF PATENTS.

Communicated by MR. VAUGHAN, PATENT AGENT, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1453. George Rydill, Dewsbury, Yorkshire, "Improvements in treating mixed fabric rags containing vegetable and animal fibre, and known in the trade as linsey skirtings, shallies, frieze, serge, extract wood, shoddies, and waste, to destroy the cotton and obtain a yellow colour, and give a milling or felting property to extract rags and extract material.—Petition recorded June 11, 1864.

1301. John Baird and John McIntyre, Alexandria, Dumbartonshire, N.B., "Certain improvements in apparatus employed for clearing and bleaching textile fabrics."—Petition recorded May 25, 1864.

1374. William Clark, Chancery Lane, Middlesex, "Improvements in the mode of heating animal, vegetable, and mineral matters, whereby to effect their desiccation, vaporisation, decomposition, reduction, fusion, or volatilisation, and in apparatus for the same."—A communication from Henri Adolphe Archereau, Boulevart St. Martin, Paris.—Petition recorded June 2, 1864.

1498. George Hyacinthe Osouf, Rue St. Appoline, Paris, France, "Improvements in the manufacture and utilisation of carbonic acid, and in apparatus connected therewith."—Petition recorded June 16, 1864.

1507. William Clark, Chancery Lane, Middlesex, "Improvements in apparatus for washing or dyeing skeins of thread, silk, cotton, and other fibrous materials."—A communication from Claude Verdt, Boulevart St. Martin, Paris.

1509. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "The manufacture of lyes or liquors applicable to the cleansing and bleaching of wool and other fibrous substances, as well as of textile fabrics."—A communication from Madame Rosine Saiglan Bagnéres' Paris, France.

1510. Thomas Townsend Coughin, Crucifix Lane, Bermondsey, Surrey, "Improvements in apparatus for compressing air or gases to be applied to various useful substances."

1513. William Henry Tooth, Rhodeswell Road, Stepney, Middlesex, "Improvements in furnaces or apparatus for generating carburetted hydrogen, carbonic acid, carbonic oxide, and cyanogen gases."

1514. William Henry Tooth, Rhodeswell Road, Stepney, Middlesex, "Improvements in the manufacture and refining of iron, and in the manufacture of steel."—Petitions recorded June 17, 1864.

1525. Richard Smith and Christian Sieberg, Glasgow, N.B., "Improvements in obtaining colouring matters."

1529. Joseph Hamilton Beattie, Dowgate Hill, London, "Improvements in the means of preventing the formation of, and in the removal of, incrustations or deposits from steam-engine boilers."—A communication from Joseph Marks, Montreal, Canada.—Petitions recorded June 20, 1864.

Notices to Proceed.

460. Arthur Wall, Clapton, Middlesex, "An improved combination or improved combinations of combustible materials to be used as fuel."—Petition recorded February 24, 1864.

482. Alexander Prince, Trafalgar Square, Charing Cross, Middlesex, "Improvements in filtering apparatus."—A communication from François Michel and Aimé Pruvot, Paris, France.—Petition recorded February 26, 1864.

497. Frederic Weil, Paris, France, "Improvements in coating metals with one or several other metals, and in oxidising the surface of these latter."—Petition recorded February 29, 1864.

504. John Chapman, Albion Street, Hyde Park, Middlesex, "Spine-bags to be employed in controlling the circulation of the blood by the combined or independent application of ice or iced water and warm water or other fluid to the region of the spinal cord."—Petition recorded March 1, 1864.

528. Frédério Pierra Langenard, Rue des Trois Couronnes, Paris, France, "Improvements in centrifugal machines for extracting juice of plants or drying up substances or materials of various kinds."—Petition recorded March 2, 1864.

770. Michael Henry, Fleet Street, London, "Improvements in apparatus for supplying air to persons employed under water, or in places where noxious gas, air, or vapour prevails."—A communication from Benoist Rouquayrol, Boulevart St. Martin, Paris, France.—Petition recorded March 28, 1864.

1486. Robert Whiteside, North Egremont, Cheshire, "Improvements in preserving iron ships and ships' sheathing from corrosion and fouling, and in apparatus to be employed therefor."—Petition recorded June 15, 1864.

CORRESPONDENCE.

Continental Science.

Paris, July 14, 1864.

The Association for the advancement of astronomy and meteorology will give a grand *soirée* at the Observatoire on the 20th, which promises to be a very brilliant affair. This Society, which I have already alluded to as the thriving child of M. Leverrier, is making great progress in the provinces. At their first general meeting held a short time since a sum of 50,000 francs was voted for the construction of a telescope which will be placed in one of the provincial towns. As yet they have not determined which city is to be the fortunate recipient, but no doubt the one containing the greatest number of subscribers will have the best chance. They offer a prize of 4000 francs for the best treatise on telegraphic meteorology, and four annual prizes of 300 francs each for the best marine meteorological observations. Three prices of 500 francs each to the authors of the best meteorological observations as affecting agriculture are also offered. The annual subscription is only ten francs, and ladies are eligible as members.

The Abbé Moigno gives his second lecture to-night on the Progress of Science during the past month, and to judge from the programme it will include a very large number of interesting subjects. I notice, however, that the learned Abbé rather shirks chemical subjects, considering possibly that his hearers would not be able to stand much strong food at present.

The *Revue Maritime et Coloniale* has just discovered a mare's nest in the fact that the French artillerymen in Mexico found it necessary to alter the prescribed elevation of their guns for each range on account of the air of the Mexican high-level plains being rarer than that of their practice ground at Vincennes. The real wonder would be if it had not been so. The "Revue" claims for the French rifled cannon the merit of being the most perfect in the world in point of length of range and accuracy of flight. It is plain, however, that neither the editor nor the writer has ever seen a day's practice at Shoeburyness, or they might be induced to alter their opinion on this subject. The French rifled guns must do a great deal more than has yet been made public before they can attempt to compete either in size, range, accuracy, or destructive power with the weapons of Whitworth or Armstrong. The same journal gives a very full and fair account of Captain Palliser's invention of chilled cast-iron shot, and bestows so much praise on the gallant inventor that one cannot help pardoning the little performance on the trumpet I have just mentioned.

They have just discovered a well containing water at Pompeii, all the others hitherto found having been dry. A specimen of the water has been sent to Professor A. Lura for analysis, but I do not suppose its composition will differ much from that found in the same district at the present day.

M. L. Wilhelney has lately published a series of observations on the capillarity of a large number of liquids, using in his experiments plates of pure platinum and copper. They seem to prove that there is no relation between the capillary co-efficients and the chemical composition of the bodies examined.

I hear that a company with a capital of 170,000,000 reals (about £17,000,000), has been formed in Spain for the purpose of carrying a telegraph across the Atlantic by a new route. Starting from Cadiz, it will touch at the Canary Islands, Cape Verde, at Fernando di Noronha, thence across the Atlantic to Brazil, and so on to French Guiana, the Antilles, Porto Rico, and Havanah, where a series of lines will join it with the North American continent. The longest submarine section will be only about 750 miles. The advantages both from an electrical and a commercial point of view of laying a long line in short sections is so well known to your readers that I will not enlarge upon it. A few days since I was in the company of one of the engineers lately employed in laying the Persian Gulf line, and, from what he told me, I fancy that we are just beginning to find out that we know little or nothing about the electrical anomalies that start up so continually in working a submarine line of any length.

Professor Tyndall attended the last meeting of the *Académie des Sciences*, and was welcomed with all that well-bred courtesy which French savans know so well how to show, but which they sometimes so unaccountably forget when they take a pen in their hands.

M. Deiss, one of the largest manufacturers of bisulphide of carbon in this country, has earned the gratitude of his workmen and neighbours by devising an apparatus, containing hydrate of lime, which effectually absorbs the waste sulphuretted hydrogen given off during the process. At the suggestion of M. Payen, M. Deiss has substituted for the lime, sesquioxide of iron mixed with sawdust. The products resulting are water and sulphur, the latter being recovered by simple washing with bisulphide of carbon and subsequent distillation. The oxide of iron is then calcined, and is once more ready for use. The idea has, of course, been taken from the method of gas purification now adopted by many companies, but the application is new, and MM. Payen and Deiss deserve great credit for carrying it out so successfully.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Employment of Fluohydrate of Fluoride of Potassium in Analysis, by WOLCOTT GIBBS, *M.D., Rumford Professor in Harward University.*

THE facility with which the double fluoride of titanium and potassium separates in a crystalline state from hot aqueous solutions, on cooling, suggested to Wohler the best method at present known for obtaining pure titanic acid. In Wohler's process, rutile or titaniferous iron is fused with an excess of carbonate of potash, the fused mass treated with water, which leaves the greater part of the iron undissolved, and the filtrate saturated with fluohydric acid. By re-crystallisation the fluotitanate TiF_2,KF, or, perhaps, more correctly, $Ti_2F_4,2KF$ may be obtained in white scaly crystals, resembling boric acid; from this salt pure titanic acid is easily obtained by precipitation with ammonia. Marignac modified this process very advantageously in the treatment of zircon to obtain pure zirconic acid. The zircon was fused with fluohydrate of fluoride of potassium directly. In this manner a perfect resolution of the mineral was easily obtained; the fluozirconate of potassium was then dissolved out from the insoluble fluosilicate by hot water, acidulated with fluohydric acid. The observations of Wohler and Marignac suggested to me a further extension of the same process, the general result of the investigation being that fluohydrate of fluoride of potassium or sodium may be employed with great advantage in resolving minerals containing metallic oxides of the types RO_2 and R_2O_3. The special results are as follows:—

Glucinum.—Glucina, purified from iron and alumina by the usual methods, is to be fused with twice its weight of fluohydrate of fluoride of potassium, and the fused mass treated with boiling water, to which a small quantity of fluohydric acid has been added. On filtering, a notable quantity of the insoluble fluoride of aluminium and potassium almost always remains upon the filter, even when the separation from glucinum has been carefully executed, by means of carbonate of ammonia. The filtrate on cooling deposits colourless transparent crusts of the double fluoride of glucinum and potassium, which are easily purified by recrystallisation. This method affords the simplest—I am almost disposed to say the only—method of obtaining a chemically-pure salt of glucinum. The double salt is apt to contain an excess of fluoride of potassium. To obtain it perfectly pure for analysis, Mr. J. C. Newbery fused the fluohydrate of potassium with an excess of glucina. The salt as thus obtained gave him:—

	Calculated.	Found.
Glucinum	5·74	5·70
Potassium	47·73	47·76
Fluorine	46·53	46·50
	100·00	99·96

which corresponds precisely with the formula—

$$G_2F_3+3KF,$$

if glucinum be taken as 7, or with $GF+KF$, if glucinum be taken as 4·66. In this analysis the fluorine was estimated by the loss. Berzelius gives the formula—

$$G_2F_3+3KF.$$

Glucina may be obtained directly from beryl, as Mr. Newbery[*] has found, by fusing the finely-pulverised mineral with fluohydrate of potassium, dissolving out the soluble double fluoride of glucinum and potassium, and purifying by re-crystallisation. As, however, beryl contains only 13 or 14 per cent. of glucinum, this process is not economical. It is better to separate the other oxides as far as possible by the ordinary methods, and then to purify the crude glucina by the process above pointed out. It is, perhaps, worthy of notice that while almost all proto- and sesquioxides give insoluble double salts, with fluoride of potassium, the fluoride of glucinum behaves like a bifluoride, so as to suggest that glucina may possibly be GO_2 instead of GO or G_2O_3.

Ammonia precipitates glucina directly from the solution of the double fluoride. When a solution of fluoride of sodium is added to the one of aluminium and glucinum, the whole of the aluminium is thrown down in the form of cryolite, $Al_2F_3,3NaF$, while the glucinum remains in solution. It is probable that this method will give accurate quantitative results.

Tinstone.—Mr. J. W. B. Hallett has found that tinstone is very easily resolved by fusion with three or four times its weight of fluohydrate of potassium. The mineral must be finely pulverised. The fused mass may be treated directly in the crucible with sulphuric acid to expel fluorine, after which, by adding water, filtering and boiling the filtrate, the whole of the tin may be thrown down as stannic acid, which is to be separated from traces of iron in the usual manner. This method of resolving the ore of tin is very much more convenient than fusion with caustic alkalies, or with sulphur and carbonate of soda.

(To be continued.)

On Fluoride of Thallium, by M. F. KUHLMANN.

LIQUID hydrofluoric acid attacks thallium with difficulty; in this respect thallium resembles lead. Its action on carbonate of thallium is more energetic, and by this means crystallised hydrated fluoride is obtained. Its crystals are white, some of the facets possessing a diamond-like brightness; they do not blacken by exposure to light; and from M. des Cloizeaux's optical examination, seem to originate from an oblique rhomboidal prism.

Fluoride of thallium can be entirely volatilised and transformed into a very bright satiny white crystalline mass, becoming black in the light, like chloride of silver; analysis has given for its composition the formula $TlFl$.

A solution of fluoride of thallium preserves an acid reaction even after several crystallisations of the fluoride. The crystallised salt has little stability; it decomposes slowly in the air, with disengagement of hydrofluoric acid, which attacks the glass. The solubility of fluoride of thallium establishes another analogy between this and alkaline metals; but this analogy becomes still greater and assumes a high scientific interest from the existence of a double fluoride of thallium and silicium, the composition of which is given in the formula $TlSiFl_2+2HO$, and which, treated by concentrated sulphuric acid, gives fluoride of silicium and hydrofluoric acid. This double fluoride is obtained by the action of hydrofluosilicic on carbonate of thallium. Fluoride of thallium and silicium, as well as simple fluoride, is very soluble in water; this solution has an acid reaction, and slowly deposits a little silica. Further, this compound attacks glass only after some length of time, and distils without decomposing. Its crystalline form belongs to the cubic system.—*Comptes Rendus*, lviii, 1037.

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[*] Professor Jay had already remarked that beryl may be completely resolved by fusion with fluoride of potassium. See *American Journal of Science* for July, 1863.

PROCEEDINGS OF SOCIETIES.

CANTOR LECTURES.

"*On Chemistry Applied to the Arts.*" *By Dr.* F. Crace Calvert, *F.R.S., F.C.S.*

Leather.—The art of the currier. Morocco, Russia, and patent leathers. The art of tawing skins. Chamois and glove skins. Parchment. *Hair*, its composition and dyeing. *Wool*, its washing, scouring, bleaching, and dyeing. *Silk*, its adulterations and conditioning.

Lecture III.

Delivered on Thursday Evening, April 14, 1864.

I shall have to crave the indulgence and patience of my audience during this lecture, as it will chiefly consist of descriptions of processes for the most part well known to manufacturers and others engaged in the leather trade. Thus the art of currying, which is applied principally to such leathers as are intended for the upper parts of shoes, for harness, &c., is carried on at the present day nearly as it was fifty years ago, and still is but little known to the public.

Currying.—The objects in view in currying leather are several: to give it elasticity—to render it nearly impermeable—to impart to it a black or other colour, and, lastly, to reduce it to uniform thickness. These qualities are imparted by the following processes:—After the leather obtained from hides or the thicker qualities of skins has been damped, it is placed on a stone surface and energetically rubbed—first with a stone, then with a special kind of knife called a slicker, and lastly with a hard brush. The leather is then ready to be stuffed or dubbed, which consists in covering it on the fleshy side with tallow, and hanging it in a moderately warm room; and as the water contained in the leather evaporates, the fatty matter penetrates into the substance of the leather and replaces it. The dubbing process is then repeated on the other side of the leather, which is now ready to be softened and rendered flexible, which is effected by rubbing it with a tool called a pummel. The leather then undergoes the last mechanical operation, which reduces it to uniformity of thickness by shaving off the inequalities of its surface by means of a peculiarly shaped knife called a slicker. The greatest part of the curried leather is blackened on the grain side by rubbing it with grease and lamp black, and lastly brushing it over with a mixture of grease and glue. I believe that some kinds of curried leather are dyed by a purely chemical process, in rubbing the tanned skin, first with iron liquor, and then with a solution of gall nuts or other tanning substance. The most tedious of the foregoing processes is that of dubbing, which has been greatly improved of late years by the Americans. The scoured skins are placed in a large revolving drum, of ten or twelve feet diameter, and lined inside with wooden pegs. A certain quantity of tallow is then introduced and the whole set in motion, and whilst the hides are thus tossed about, a current of warm air is passed through the drums, which carries off the moisture and allows the grease to penetrate the hide. By this means thick hide leather can be stuffed in four or five days.

Split Leather.—A large branch of trade has sprung up within a few years owing to the invention of machinery for splitting hides, skins, and kips, by which, although the quantity of leather has been considerably increased, I am afraid it is at the expense of its quality.

Fancy Leathers.—Allow me now to give you a slight insight into the methods of preparing various fancy leathers, such as Morocco, Russia enamelled, tawed, or kid leather, used for soldiers' belts, gloves, &c., and, lastly, oiled leathers, used for washleather, gloves, &c. Until the middle of the eighteenth century Morocco leather was wholly imported from that country, for it was in 1735 that the first Morocco works were established in Paris, and similar manufactories were soon set up in various parts of the Continent and in this country. The process by which Morocco leather is prepared is as follows:—The goat and sheep skins, which are especially used for this branch of manufacture, are softened, fleshed, unhaired, and raised or swelled by methods similar to those already described, but one essential element of success in this kind of leather lies in the perfect removal of all lime from the skins, which is effected by plunging the well-washed skins in a bath of bran or rye flour, which has been allowed to enter into a state of fermentation. The result is, that the lactic and acetic acids generated by fermentation of the amylaceous substances combine with the lime and remove it from the skins. The other essential point is the mode of tanning the skins. Each skin is sewn so as to form a bag, and filled, through a small opening, with a strong decoction of sumac, and after the aperture has been closed the skins are thrown into a large vat containing also a decoction of the same material. After several hours they are taken out, emptied, and the operation is repeated. To render these skins ready for commerce it is necessary to wash, clean, and dye them. The latter operation was formerly tedious, and required great skill, but since the introduction of tar colours, the affinity of which for animal matters is so great, it has become comparatively easy. The skins, after they are dyed, are oiled, slightly curried, and the peculiar grain, characteristic of Morocco leather, is imparted to it by means of grooved balls or rollers. There are two inferior kinds of Morocco leather manufactured, viz., those called *roan*, prepared in a similar way to Morocco, but not grained, and *skivers*, also prepared in the same manner, but from split sheep skins. I owe to the kindness of Mr. Warren De la Rue the beautiful specimens of leather before me, which will enable you to appreciate the various qualities of these interesting productions.

Russia Leather.—The great esteem in which this leather is held is owing to its extreme softness and strength, its impermeability, and resistance to mildew, which latter property is imparted to it by the use of a peculiar oil in its currying, that is birch-tree oil, the odour of which is well-known as a distinguishing feature of Russia leather. As to its preparation I will merely state that it is very similar to that of Morocco, with these differences, that hot solutions of willow bark are used instead of sumac; that it is generally dyed with sandal wood and a decoction of alum; and, lastly, as already stated, the birch-tree oil is used in currying it.

Enamel Leather.—This class of leather is usually prepared with calf and sheep skins tanned in the ordinary manner. They are dyed black by rubbing them over with a decoction of logwood, and then iron liquor or acetate of iron. The leather is softened with a little oil, and is ready to receive a varnish, which is applied by means of a brush, and composed of bitumen of Judea, copal varnish, oil varnish, turpentine, and boiled oil.

Tawed or Kid Leathers.—The manufacture of this class of leathers differs entirely from those already described, as their preservative qualities are imparted by quite different substances from those used with other leathers, the preservative action of the tannin being substituted by that of a mixture of alum and common salt. Let us examine together a few points connected with the production of this class of leather. One of the most interesting characteristics is the method of unhairing sheep, lamb, and kid skins, after they have been well washed and fleshed on the beam. The old process of unhairing by smearing on the fleshy side with a milk of lime, was improved by mixing with the lime a certain amount of orpiment, or sulphuret of arsenic, but Mr. Robert Warrington having ascertained that the rapid removal of hair in this case was not due to the arsenic, but to the formation of sulphuret of calcium, proposed, with great foresight, the following mixture as a substitute for the dangerous and poisonous substance called orpiment—viz., three parts of polysulphuret of sodium, ten parts of slacked lime, and ten parts of starch. The polysulphuret of sodium may be advantageously replaced by the polysulphuret of calcium. The skins, unhaired by any of these processes, are now ready to be placed in a bran or rye bath, as with Morocco leather, or in a weak solution of vitriol, to remove, as already stated, the lime. After the lime has been thoroughly removed from the skins, they are dipped in what is called the white bath, which is composed, for 100 skins, of 13 to 20 lbs. of alum, and 4 to 5 lbs. of chloride of sodium or common salt, and the skins are either worked slowly in this bath or introduced into a revolving cylinder to facilitate the penetration of the preservative agent, which, according to Berzelius, is chloride of aluminium resulting from the action of the chloride of sodium on the alum. When the manufacturer judges that the skins have been sufficiently impregnated with the above mixture, he introduces them into a bath composed of alum and salt in the same proportions, but to which is added 20 lbs. of rye flour and 50 eggs for 100 skins. After remaining a few hours they are removed, and allowed to dry for about fifteen days, and are then softened by working them with a peculiar iron tool, and the white surface which characterises that class of leather is communicated to them by stretching them on a frame and rubbing them with pumice-stone. A large quantity of tawed leathers are also preserved retaining their hair, which is done by simply suppressing the unhairing and rubbing processes.

Chamois, Wash, or Oiled Leather.—This class of leathers are named from the fact that formerly they were exclusively produced from the skin of the chamois, but at the present day sheep, calf, and deer skins, and even split thin hides, are manufactured into this kind of leather. I should also state that the employment of this kind of leather has greatly decreased of late years, owing to the general substitution of woollen fabrics in articles of clothing. You will see by the following description that the preparation of this class of leather differs entirely from those previously detailed; the conversion of skins into leather, or from a substance subject to putrefaction to one free from that liability, being no longer effected by tannin, as in the case of hides, and Morocco and Russia leathers, or by the use of mineral salts, as in the case of tawed leathers, but by that of fatty matters, especially animal oils, such as sperm. The skins are prepared in the same manner as for tawed leathers, and then submitted to what is called the prizing operation, which consists in rubbing the hair side of the skin with pumice stone and a blunt tool or knife, until the whole of the rough appearance is removed, and the skin has acquired a uniform thickness. They are then worked on the peg until the great excess of moisture has been wrung out, and plunged into the trough of a fulling mill, to the action of the wooden hammers of which they are subjected until nearly dry. They are then placed on a table and oiled, and several of them, after being rolled together, are replaced in the trough of the fulling mill. When the oil has been thus worked into the substance of the skins, they are removed, exposed to the atmosphere, again oiled, and once more subjected to the fulling mill; after which they are placed in a moderately heated room for a day or two, the object of which is twofold, viz., to facilitate the evaporation of the water and the penetration of the oil, and to create a slight fermentation, by which the composition of certain of the organic substances have undergone such modification as to enable them to combine in a permanent manner with the fatty matters. These processes are repeated until the manufacturer deems the leather sufficiently prepared to be fit to undergo the following operations, viz., to be immersed for several hours in a caustic lye bath, to remove the excess of oily matter, washed, and pegged. It is only necessary to stretch the leather on a table, then on a horse, and lastly between rollers, after which it is ready for the market. The ordinary buff colour of these leathers is communicated by dipping them, previously to the finishing processes, into a weak solution of sumac. Before speaking of the further processes necessary to fit these leathers for the glove manufacturer, allow me to have the pleasure of describing that of Mr. C. A. Preller, whose mode of preparing leather is very interesting, owing to the rapidity with which he converts hides into leather, and also to the remarkable toughness which his leather possesses. To attain these desirable ends Mr. Preller proceeds as follows:—The hides are washed, slightly limed, unhaired, fleshed, and partially dried; they are then smeared with a mixture made of fatty matters and rye flour, which having been prepared a few days previously has entered into fermentation, and which has so modified the fatty matters as to render them more susceptible of immediate absorption by the hide. I think that this feature of Mr. Preller's plan deserves the serious notice of all engaged in the manufacture of oiled leathers, as it appears to prove that fatty acids (or modified fatty matters) are better suited for combination with skins than neutral fats. The hides, with additional fatty matters, are then introduced into the large American drums, previously noticed in speaking of currying, and after four days they are removed, washed in an alkaline fluid, worked with a pummel and slicker, and after being dried they are ready for market.

Gloves.—The manufacture of this article is now a most important branch of trade, and is the means of giving employment to large numbers of people in several towns in this country as well as on the Continent. To render the above-mentioned oiled leather sufficiently soft and pliable for gloves it is necessary to submit it to the following further operations:—The Chamois, kid, or other skins are rubbed over with a solution composed of 1 lb. of soap, dissolved in half a gallon of water, to which is added 1½ lb. of rapeseed oil and twenty yolks of eggs, or, what has been recently found to answer better than eggs, a quantity of the brains of animals reduced to pulp. The use of the two latter substances is extremely interesting in a scientific point of view, for they both contain a peculiar nitrogenated matter called vitalline, and special fatty matters called oleophosphoric and phosphoglyceric acids, which doubtless, by their peculiar composition, communicate to the skins those properties which characterise this class of leather. The skins are then washed and dyed in various colours, after which they are softened, and rubbed with an instrument adapted to slightly raise the surface, and give it that well-known velvetty appearance belonging to glove skins. I shall not take up your time by entering into the details of dyeing these leathers, but describe the following process for bleaching them:—

Bleaching of Skins.—The only process known until recently for imperfectly bleaching chamois and glove skins was that of submitting them to the influence of the fumes of sulphur in combustion or sulphurous acid, but latterly two modes of attaining that object have been proposed. The first consists in dipping skins for two days in a weak solution of neutral hypochlorite of soda, washing, drying, and rubbing them with soap and oil. The second mode is to dip glove skins into a solution of permanganate of potash, when they soon assume a brownish colour, due to the liberation of the oxygen of the permanganate of potash, and the fixation of the hydrate of sesquioxide of manganese by the skin. The skins so acted on are washed and then dipped in a solution of sulphurous acid, which becomes converted into sulphuric acid by the action of the oxygen of the sesquioxide of manganese, and the protoxide thus produced unites with the sulphuric acid, which is soluble in water. The skins thus bleached when dressed are ready for market.

Gilding of Leather.—The usual mode of ornamenting leather with gold is to apply, in such parts as are desired, a thick solution of albumen, covering those parts with gold leaf, and applying a hot iron, when the albumen is coagulated and fixes the gold. This plan is objectionable when the goods are intended for shipment, and the following method, lately proposed, is far preferable:—On the parts required to be gilt, a mixture, composed of five parts of copal and one of mastic, are spread; a gentle heat is applied, and when the resins are melted the gold leaf is spread upon them.

Parchment.—There are two distinct qualities of this valuable material, which has been used from time immemorial as a means of preserving records. The best quality is prepared from young lamb, kid, and goat skins, and the second quality from calf, wolf, ass, and sheep skins. To make parchment, the following is the process:—The skins are stretched on strong rectangular frames, limed, unhaired, fleshed very carefully, and rubbed with pumice stone until the skins have acquired the proper thickness. They are then dried very carefully in the shade.

Dialysis.—Thomas Graham, Esq., Master of the Mint, has lately drawn the attention of the scientific world to a most remarkable property possessed by organic membranes of separating, when in solution, crystallisable bodies from those which are not so. The former he names crystalloids, and the latter colloids. For instance, if a solution of sugar (crystalloid) is mixed with one of gum (colloid) and placed in the vessel, the bottom of which consists of a septum of animal or vegetable parchment, the crystalloid sugar will pass through the membrane into the surrounding water, whilst the colloid gum will remain in the vessel. Again, if solutions of iodide of potassium and albumen be mixed together, the iodide of potassium will diffuse itself through the membrane, which the albumen will not do. Also, if to an alkaline solution of silicate of soda weak hydrochloric acid be cautiously added, chloride of sodium will be produced, and silica will remain in solution; and if such a solution be placed in the dialyser, the chloride of sodium (the crystalloid) will diffuse itself through the membrane, while the silica (the colloid) will remain behind. It is impossible to calculate the immense service which the discovery of these facts by Mr. Graham will render to physiology, toxicology, or to manufactures, as, in fact, every day new applications of it are being made in these various departments of human research. Thus, to give an example which has special reference to these lectures, I have lately seen it proposed by Mr. A. Whitlaw to place salted meat in large dialysers, when it is stated that the salt only will be removed, leaving all the nutritive properties of the meat undiminished. Mr. Whitlaw also proposes to dialyse the brine in which meat has been salted, and thus to remove the salt, leaving the juice of the meat available for use, while the salt is again in condition to be employed as before.

It will now be my agreeable duty to examine with you a few facts relating to hair and wool. It is interesting to observe that hair, wool, feathers, nails, and claws may be all considered as prolongations of the epidermis, and present nearly the same chemical composition, as will be seen by the following table:—

	Epidermis of Man.	Hide.	Man's nails.	Hair.	Quill.	Horse's hoof.	Scale of reptile.
Carbon	50·89	50·89	51·09	50·14	52·43	50·40	53·60
Hydrogen	6·81	6·78	6·12	6·67	7·22	7·00	7·20
Nitrogen	17·22	17·25	16·91	17·94	17·93	16·70	16·30
Oxygen and Sulphur ..	25·08	25·08	25·88	25·25	22·42	25·90	22·90
	100·00	100·00	100·00	100·00	100·00	100·00	100·00

These substances have also this peculiarity, that, notwithstanding their great richness in organic matters, they are extremely slow to decompose.

Hair.—The only real point of interest connected with hair appears to me to be the question as to what its various colours are to be ascribed, and I regret that here I can only give conjectures and not positive facts. Vauquelin and Fourcroy, who analysed hair most carefully half a century ago, stated that hairs were hollow cylindrical tubes filled with oils of various colours; but Gmelin and others state that the coloration of hairs is due to the different proportions of sulphur that they contain.

QUANTITY OF SULPHUR IN HAIR.

Brown	4·98
Black	4·85
Red	5·02
Grey	4·03

Recently Mr. Barreswil has published a paper, in which he states that the coloration of hairs is probably due to the proportion of iron in their composition, and he argues that as iron is the essential element of the colouring matter of blood, it is highly probable that it fulfils the same office with respect to hair. I may state, *en passant*, that also great improvements have lately been made in dyeing human hair. Formerly the patient had to undergo most unpleasant treatment, his head being covered with a paste consisting of three parts of lime and one of litharge. An oil cap was then applied and the patient left for twelve hours, when the disagreeable operation of removing the mass and clearing the hair was proceeded with. The black dye communicated to the hair in this process was due to the sulphur of the hair combining with the lead of litharge, and forming black sulphuret of lead. The present process consists in cleaning the hair thoroughly with a strong alkaline soap, or a little weak alkali, then carefully applying a solution of nitrate of silver, and lastly a solution of monosulphuret of sodium.

Wool differs from hair chiefly by its property of felting, which it owes to its numerous cross lines or serratures, as they are termed; the finer the wool the greater the number of its serratures. Thus, whilst Mr. Goss has found in the finest Saxony wool 2720 of these serratures in a single inch in length, he only found 2080 in an inch of South Down wool, and 1850 in Leicester. The wool of sheep can be classed under two heads, that is, into long wool and short wool. Certain classes of sheep will maintain the type or quality of their wool under every circumstance. Such are the original types of South Down, Norfolk, and Dorset, all of which are short wool, and all these sheep feed upon fine and short grass. It has been observed that if they are fed upon coarse grass, their wool will also become coarse. This is also true with Welsh, Scotch, and even Spanish merinos. A further proof that the view appears correct is, that the long-wool sheep, such as those of Leicester, Lincoln, and Kent, feed in valleys where grass is long and coarse. In all cases the size of the animal appears also to correspond with their class of food. Another curious fact is the facility with which one type of sheep will merge into another if they change food and climate. Thus many attempts have been made to introduce into France our Leicester breed, the wool of which is so remarkable for its fineness, length, and silvery appearance. Still, after four or five years' residence there, the wool has lost its most valuable qualities. In fact, they are no more the Leicester breed. The coarse wool of sheep, however, such as those of Devonshire, does not appear to be so rapidly influenced by any change of climate which the animal may undergo. The aptitude which various kinds of wool have for dyes is also interesting. Thus the wool of one kind of sheep will not dye with the same facility as that of another; and wool dyes much more uniformly, if the animal has been washed before shearing than when the washing is performed upon the wool afterwards. Lastly, the wool removed by the liming process before described will be far inferior in dyeing properties to wool taken from the same kind of animal during life. It may be interesting to some present to know the best method of removing these irregularities. I was engaged during my assistantship at the Gobelins in investigating this matter, and I found that the best plan was to steep the wool for twenty-four hours in lime water, and then to pass them through weak hydrochloric acid. Wool, as it leaves the animal, is not fit for either dyeing or spinning. Thus, when wool is washed with water, it yields a large quantity and variety of substances, which in France bear the name of *suint*. The most interesting fact connected with this is, that the 15 per cent. yielded by wool does not contain, as shown by M. Chevreul, any salts of soda, but a large quantity of salts of potash, the greatest part of which is combined with an acid called sudoric; and what increases the interest of this fact is that Messrs. Maumené and Rogelet displayed at the last Exhibition salts of potash which they had obtained commercially from this new source. In fact, they have established in several of the large manufacturing centres of France, where considerable quantities of wool are used, factories for the extraction of salts of potash from the *suint*, and they supplied the jury with the following particulars:—That a fleece of wool weighing 8 lbs. yielded on the average about 1½ lb. of dry suint, or sudorate of potash, and this would further yield about seven ounces of pure potash. If it is now considered that there is annually twenty million pounds of wool washed in Rheims, thirty millions at Elbeuf, and four millions at Fourmies, it would appear from this quantity that if it were all subjected to Messrs. Maumené and Rogelet's treatment, about 2¼ million pounds of pure potash might be recoverable. For further details on this point see Dr. Hofmann's report on chemical products and processes in the last Exhibition. Wool which has been simply washed, as above described, is not sufficiently free from extraneous matters to be fit for application in manufactures. It is necessary that it should be scoured, for which purpose, on the Continent, it is allowed to remain for some time in putrid urine, or weak ammoniacal liquor, but in this country it is placed in strong alkaline of soap or soft soap, passed through rollers to press out the excess of soap, together with the impurities which it removes, well washed, and dried. In these operations wool loses in weight above 50 per cent. when of good quality, and above 30 per cent. when inferior. But even then the wool still retains a certain amount of fatty matters, which it yields to hot alcohol.

The following table, published by M. Chevreul, will give you an idea of the composition of wool dried (at 212°):—

Earthy matters	27·40
Organic and Inorganic salts, soluble in water (*suint*)	32·74
Fatty matters	8·37
Wool	31·49
	100·000

Elementary composition, C. 50·66, H. 7·03, N. 17·74, O. 22·32, S. 2·25.

Before proceeding further, I should like to call your attention to the curious fact that the fatty matters of wool are completely different from the fatty matters of the animal itself; thus, whilst the ordinary suet will be saponified by an alkali, the fat of the wool will not undergo that change, the stearine and elearine being only converted into an emulsion. From experiments I have made I am able to state that the common opinion that the differences in quality observed in various wools are owing to their fatty matters is erroneous, as the pure wool obtained as above yielded to the dyer colours as brilliant as those presented by wools in which a part of the fatty matter still remained. Another important fact connected with the composition of wool is the quantity of sulphur it contains, which does not appear to be part of the fibre, as the matter containing it can be removed by a weak alkali without destroying the fibrous appearance of the wool, although its tenacity is greatly impaired, and its power of taking dye considerably diminished. Another remarkable fact is that when wool is bleached by sulphurous acid, the only agent known which will effect that purpose, it becomes incapable of taking many colours, especially the new and brilliant coal tar dyes. The long-disputed question among chemists—how sulphurous acid operates so as to bleach wool?—has lately been solved by Messrs. Leuchs and Weber, who have proved that sulphurous acid unites with the colouring matter of the wool, forming a colourless compound, in proof of which it appears that if the wool is placed in boiling water this colourless compound is dissolved, and the wool regains its susceptibility to dyes, though it is slightly discoloured. A slight amount of alkali added to the boiling water greatly facilitates the removal of this artificial sulphuretted compound. In a paper lately published by Mr. Grothe, he states that 100 parts of wool fix, on an average, 0·67 of sulphur, or 1·31 of sulphurous acid to bleach it, and, practically, 100 parts of wool require about 5 parts sulphur to be burnt to produce the result. I should also state that wool must always be wet before being submitted to the fumes of sulphur, and it is always advantageous to pass it previously through a soap lye or weak alkali. Wool so bleached should always be well washed in cold water to remove the excess of sulphurous acid, which otherwise, if the wool were subsequently exposed to moisture, might be converted into sulphuric acid, and destroy the fibre of the wool. It may be interesting to ladies to know the process used by a French scourer, named Jolly, to restore Cashmere shawls discoloured by time. It consists in dipping them into a solution of sulphurous acid, which bleaches the wool, but does not affect the fast colours with which the fibres composing the patterns of the shawls are dyed. The shawls then only require to be washed and pressed to be restored to their original beauty. There is no doubt in my mind that a solution of sulphurous acid might be substituted for the gas in bleaching wool with advantage and economy, owing to the sulphurous acid being in a more condensed form, and in better condition for effecting the bleaching process. A few years ago I took advantage of the fact that wool contains sulphur to produce upon it an artificial lustre. The woollen goods were passed through a weak boiling solution of acetate of lead, washed carefully in pure water, and submitted to the action of high-pressure steam, when the lead combined with the sulphur of the wool, producing galena, which gave the wool a lustre. The action was regulated by generating, under the influence of steam, nascent sulphuretted hydrogen from a polysulphuret of sodium, which facilitated the object in view. Wool is generally dyed either in the fleece, after undergoing the processes of washing and scouring, or it is first spun into yarn or worsted. To describe all the various methods of dyeing wool would far exceed the limits of this lecture. The operations of spinning wool into yarn or worsted are purely mechanical, and it is not therefore within my province to describe them. The same remark applies also to the manufacture of felt and shoddy, now so extensively carried on in Yorkshire, and I shall therefore merely refer to one or two points having reference to chemistry, such, for instance, as the working up of the wool or the cotton in worn-out fabrics. To recover the wool from such fabrics the process is most simple, consisting simply in immersing them in diluted muriatic acid, and drying them at a temperature of about 220°, by which means the cotton is completely destroyed, the wool remaining unaffected. The material is then submitted to the action of a "devil," which separates and blows away the cotton, leaving the wool ready for being worked up. To remove the vegetable fibre with the view of applying it to the purposes for which it is adapted,—as the paper manufacture, for instance,—the following process has been devised by Mr. F. O. Ward and Captain Wynants. The mixed fabric is submitted to high pressure steam (60 to 80 lbs. to the square inch), and under the influence of this high and moist temperature the vegetable fibre remains unchanged, whilst the animal one is so much disorganised that when the rags are removed from the receptacle and dried, and submitted to the action of a beating machine, the cotton fibre remains intact, whilst the animal matter falls to the bottom of the machine in the form of a dark-coloured powder mixed with small lumps of the same substance; this residue has been advantageously applied as a manure, by these gentlemen, under the name of "ulmate of ammonia." I am happy to state that chemical science has discovered several means of distinguishing cotton from wool when employed in the same fabric, and even of determining their respective weights in the same; but the aid of the magnifying powers of the microscope is often required in investigating the mixtures of wool with flax, cotton, jute, &c., which are now so extensively and so ingeniously spun together. The description of these processes, however, would involve so much technicality, and require so much time, that I must not trouble you with their details. The same remarks apply to the means used for distinguishing the materials used in mixed fabrics of silk and cotton, or silk, wool, and cotton.

Silk.—This material has always been highly esteemed, owing to its remarkable durability, and to the beauty of the fabrics produced from it. Thus, the Chinese have used silk from time immemorial, and the Romans held it in such high estimation that, at the time of the Cæsars, silk was worth its weight in gold. The most interesting fact for us is the date of the introduction of the silkworm into Europe; it is related that in A.D. 555 two monks, returning from the East, concealed some silkworms' eggs in their staves, and having succeeded in rearing the worms, their culture soon spread through Greece and Turkey, and gradually found its way into Italy towards the twelfth century. The silk in use at the present day is chiefly derived from the *Bombyx mori*, but the extensive disease which has during the last eight or ten years destroyed very large numbers of the worms, has given rise to great efforts to introduce some new species, two of which, the *Bombyx mylitta*, feeding on the *Palma christi* or castor-oil tree, and the *Bombyx ailanthus*, feeding on the plant from which it is named, have been to some extent successful. The material forming the silk is secreted in two glands placed on the side of the animal's body, whence it passes into an organ called the spinaret, on each side of which are two other glands, which secrete a gummy substance, and this uniting with the former forms the silk fibre. Permit me to add here a fact which I think will interest you—viz., the extraordinary weight of silk which a small weight of eggs will yield. Thus, four ounces of eggs will yield 87,900 to 117,000 cocoons; and as, on an average, a pound of silk requires 270 cocoons, the four ounces of eggs will give 422 lbs. of silk, or 100 lbs. of cocoons yield generally 8¼lbs., or about 14 per cent. of silk. The production of silk fibre from cocoons is extremely simple. It is effected by placing the cocoons in boiling water, which softens or dissolves the gummy matter which binds the fibres together, and the end of the fibre being detached and placed on a reel, is easily wound. This is the state in which it is usually imported into this country under the name of raw silk. When two or more of these fibres are slightly twisted together they form what it is called tram or weft, and when two of the threads are twisted in opposite directions and laid together they form organzine or warp. To render this substance susceptible of dyeing, it is necessary to remove the gum by an operation called boiling off, which consists simply in boiling the silk for some time in a soap lye, and washing and wringing it well afterwards, in which operation it loses about 21 per cent. The following table will show the chemical composition of silk:—

Gelatine	19·08	Commercial yield, 79 per cent. of silk.
Albumen	25·47	
Wax and fatty substances	1·45	
Silk fibre	54·00	
	100·00	

FIBROINE.

Carbon, 48·53; hydrogen, 6·50; nitrogen, 17·35; oxygen and sulphur, 27·62.

Conditioning Silk.—This expression implies the ascertaining of the real commercial value of silk, or, in other words, its condition, and the necessity of this has been so fully admitted that a conditioning house has existed for 40 or 50 years in Lyons, and its advantages have been so fully appreciated that similar establishments have arisen and are well supported in every town on the Continent, where dealings in silk to any amount take place. I may mention, as an instance of the universal adoption of the practice, that even in Crefeld the finest building in the town is the conditioning house. The result is that on the Continent the intervention of the conditioning house between buyer and seller has become quite a matter of course, with the happy result of abolishing a class of dishonourable dealing which is eating like a canker into the silk trade of Great Britain. I cannot understand why the attempts made to introduce this admirable system into our country have hitherto met with so little success, and can only infer that there is an unsoundness in the trade, which places many of the silk manufacturers to a great extent under the control of wealthy merchants, who, it appears, are the chief opponents of conditioning. Otherwise one would suppose that its advantages to all engaged in working up this valuable product are too obvious to require demonstration, for, taking the most lenient view of the matter, the average gain to the manufacturer by conditioning will be not less than five per cent., and this loss (if he does not condition) cannot be recovered in any subsequent stage, so that his foreign competitor has in this respect alone an advantage over him of at least five per cent. Allow me to conclude this lecture by stating in a few words how conditioning is carried on. Silk being an exceedingly hygrometric substance—its moisture varying constantly with the amount of humidity and the temperature of the atmosphere—the first operation is to ascertain the total amount of water it contains, for which purpose samples, carefully selected from the bale when it reaches the conditioning house, are weighed in delicate scales, dried in hot-air stoves, and re-weighed, the excess of moisture (beyond the 10 per cent. admitted to be the average normal quantity) being then easily calculated. The second operation carried out in the conditioning house is that of boiling off the samples dried as above, and again drying and reweighing, to ascertain the quantity of soap, oil, sugar, acetate of lead, &c., added to give weight, and the result of this operation is to show a loss of 30, 35, and even 40 per cent. instead of about 21 per cent., which is the average amount of natural gum.

ACADEMY OF SCIENCES.

July 11.

M. ROBINET communicated the second part of his "*Memoir on the Estimation and Analysis of the Gases in Potable Waters*," but a short abstract only, from which we can extract no useful information, is given in the *Comptes-Rendus*.

A paper on "*Hexylic Glycol*" was presented by M. Wurtz; and another, on "*Octylic Glycol*," by M. de Clermont. Hexylic glycol M. Wurtz has decided to be isomeric with dihydrate of diallyl. Both these glycols, we may say, were obtained by the general process described for the preparation of those bodies.

M. V. de Luynes presented a note "*On the Part which Erythrite Plays in the Immediate Principles of Certain Lichens.*" The author considers the constitution of *erythrine* as analogous to that of the compound ethers (of fatty bodies, for example), and considers that *erythrite* pre-exists there, just as glycerine exists in fatty bodies.

M. Maumené communicated a note "*On Bichloracetic Acid*," which he forms by placing monochloracetic acid in contact with dry chlorine gas. The reaction is finished in twenty-four hours, and then it is only necessary to drive off the hydrochloric acid over a water bath, after which the bichloracetic acid is left pure. The author describes the silver salt, and the results of its analysis.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture XI.—*Thursday, January* 28.

(Continued from page 22.*)*

We proceed next to a subject of the very highest interest to geologists, and one which of late has excited great attention. I allude to that of metamorphism.

In the glossary of the "Principles" of Sir Charles Lyell, metamorphic rocks are defined to be—(these are his words)—"a stratified division of hypogene rocks, highly crystalline, such as gneiss and mica schist, and so named because they have been altered by plutonic action." By "hypogene" Sir Charles Lyell means what he terms "netherform"—from below. This definition, I should state, is found in the "Principles" published in 1853. I have not referred to see whether it has been altered in subsequent editions. I venture to submit that this definition is limited in its scope, and not very precise in its construction. The last clause—"they have been altered by plutonic action," or, in plain English, "they have been changed by heat"—might mean that the rocks referred to were originally the direct result of "plutonic action," and had undergone a further change by heat while in their present position. The introduction of the words, "subsequent to their deposition," after the word "because," would make the author's meaning clear. The definition is limited in its scope, as it excludes from consideration every change in strata of sedimentary origin which does not proceed from the operation of heat alone. We shall see, by-and-by, numerous examples of metamorphism where plutonic action has had nothing to do with it. The term "metamorphism" should have a much wider acceptation, and embrace all the changes in the chemical and physical characters of sedimentary and all other rocks, caused either by thermal action—by the operation of chemical forces within the mass, or by the chemical action of other matter from without, whether gaseous or liquid. I will explain these points in the course of the present lecture.

The subject of metamorphism, I say, is one of the highest geological interest, and although several able and original observers have specially directed their attention to it, yet, like so many other fields in nearly every department of science, it is as yet comparatively unexplored. It requires both chemical and geological knowledge to investigate it successfully. These two sciences must go hand in hand. To communicate what is known on the subject would occupy several lectures, and, therefore, on the present occasion, I shall endeavour to present you with a classification of what has been actually established, or may, I think, be fairly deduced.

The first phase of the subject of which I shall speak is metamorphism by heat alone, without loss of matter. One of the simplest conceivable cases of this kind is the deposition of silica in the form of sand, its consolidation into sandstone, and the prismatic or columnar structure communicated to this sandstone by the operation of heat alone, exactly similar to what we see occurring in our blast furnaces. I have placed before you illustrative specimens from blast furnaces. This was a piece of common sandstone. It was there exposed for a long time—it may have been for several years—to a high temperature. You observe for yourselves the change which it has undergone. It has become columnar, breaking into small pieces, and reminding one of basaltic columns in miniature. This has taken place by the operation of heat alone. There is another curious specimen from the hearth of a blast furnace, showing the transformation of sandstone into something apparently quite different. This is a piece of the sandstone in its original state, grit stone, unmistakably. There is a piece of the same sandstone after exposure to a long continued heat during some years. No metamorphism can be more complete than that. There are, in addition, certain points of interest in this particular specimen. You may ask, "Are you quite sure the change is due to heat alone?"—a very proper question to put; and I regret that I cannot give you a very satisfactory and perfectly certain answer. It is just possible that certain alkaline vapours produced by the blast furnace may have acted upon it; but that is mere conjecture. It contains minute particle of metallic iron disseminated through the mass; and altogether it is one of the most singular and interesting specimens illustrative of metamorphic action by heat that I have met with in the course of many years' search. I call your attention especially to those two specimens—the one the original sandstone, and the other the metamorphosed stone. Here is another specimen, from Norway, which I received many years ago from Mr. David Forbes. It is a mica schist which had been exposed to a long continued heat in a blast furnace there. You will see that it has undergone considerable alteration in structure, or the original structure has become very much developed and more conspicuous. We have, then, a supposed conversion of amorphous carbonate of lime into saccharoidal limestone by heat alone. I may mention an observation by Darwin, at St. Jago, Cape de Verde Islands. He says that a stream of lava overflowed Muschelkalk, which, for several inches from the line of contact, was converted into beautifully crystallised marble. We have already discussed this point on a former occasion.

Then there is a metamorphism due to a rearrangement of particles, forming new chemical compounds. This is a grand object of inquiry, but one which, as yet, is extremely imperfectly investigated. I may mention as an example the transformation of clay slate into that stratified rock called gneiss. The transition in some cases is found to be most gradual. I would mention the result simply of Carius's analyses of six different specimens from Löhen, in Saxony, illustrating the gradual passage of clay slate into gneiss—clay slate distinct at the one end, and gneiss at the other. He did not succeed in detecting any appreciable difference in ultimate chemical constitution. I mean by that, that the specimens all contained the same percentage of silica, lime, and so on, though the particles were arranged differently in all the different specimens. In Switzerland, in the Churwalden Thal, is a bed of gneiss between two beds of fossiliferous slate. The slate is everywhere unchanged, both above and below; and the lower bed is of great thickness, thus proving that the gneiss could not have been heated from below, or to any great extent. That would give us reason to believe that gneiss has been the result of what I would call "thermo-hydric action," of which I will speak more by-and-by.

Then there is a metamorphism which takes place with loss of matter. An instance of this exists in the dehydration of silicate of alumina, as in the conversion of argillaceous deposits into slate. Then I might refer to porcelain jasper, which is nothing more than a variety of clay which has been heated for a long time. Occasionally, we meet with specimens of this on coal-pit mounds which have been spontaneously ignited, and where the carbonaceous shale has been slowly burning for many years. There is a well-known locality—Fieryholes, near Dudley,—where you will meet with magnificent specimens of this. You will sometimes find a fragment consisting of alternate bands of red and greyish green, as distinct as possible. As another example of metamorphism by loss of matter, I might mention the intrusion of trap into coal, where the coal is coked in the immediate vicinity of the trap, and certain volatile products are formed, the coal suffering loss of matter in this case; but it is astonishing to observe to how slight an extent, apparently, this alteration due to the intrusion of trap takes place. I have very often particularly noticed this in collieries where trap has been intruded.

Intermixture with contiguous matter is another source of metamorphism. I will mention one example, where a pyroxenic rock, of which Bunsen speaks very copiously in his paper on the volcanic phenomena of Iceland, is traversed by a dyke of trachyte. This dyke in the interior is pure white, and becomes darker and more ferruginous as it approaches the surrounding rock. He took specimens, and analysed them, from the interior of the dyke, from the cheek of the dyke, and also from a part of the surrounding rock. I should tell you that Bunsen, in this paper, says that two kinds of materials have been ejected by volcanic action. One of these is typified by the trachytic rock, which is rich in silica, containing about 80 per cent. of silica. Obsidian is an example of this material. The other substance is the pyroxenic mass, containing about 50 per cent. of silica. These are the details of the analyses of the three kinds of specimens which Bunsen procured :—

	From the centre of the vein.	From the cheek of the vein.	From the rock immediately surrounding the vein.
Silica . . .	78·95	66·18	50·25
Alumina . .	7·71	9·74	12·55
Protoxide of iron	4·32	12·05	16·13
Lime . . .	1·55	4·49	11·10
Magnesia . .	0·42	3·04	7·59
Potash . .	2·48	0·94	0·34
Soda . . .	4·57	3·56	2·04
	100·00	100·00	100·00

The material taken from the cheek of the vein or dyke represents a mixture of 0·6 of the pyroxenic mass with 1·0 of Bunsen's normal trachyte, which is wall typified by the analysis of the substance taken from the centre of the dyke. He finds from these three analyses that there has been a most gradual passage from the trachytic dyke into the pyroxenic rock, as the two came in contact. This, then, is an example of metamorphism by admixture with contiguous matter.

Metamorphism is occasioned also by thermo-hydric action. I take these two Greek words, though I might call it "thermo-aqueous," which appears to me to be a very good term to express this process. I have already brought before you several remarkable instances of this action when speaking of Daubrée's researches. You will remember the action of water at 400° C. upon glass. In some of the experiments part of the glass operated upon was only exposed to steam. This is a point well deserving of careful note. The tubes were not filled, but notwithstanding, the portion of the glass exposed only to the action of steam was acted upon with equal intensity with the glass exposed to the direct action of the liquid water. This is a point which really has an important bearing on geological phenomena, considering the influence, or what may be the influence, of superheated steam. The natural volcanic glass, obsidian, you remember, was similarly acted upon by water at this high temperature. It completely lost its vitreous character, and was changed into a crystalline fine-grained trachyte. The powder under the microscope presented all the characters of felspar. Obsidian differs from felspar in containing a little more silica, and this is easily removed along with the alkaline silicate dissolved out of the glass, the residue consisting of felspar. Further, I may call to your recollection that pure kaolin —china clay—when heated under similar conditions with the concentrated water of the mineral springs of Plombières, which contains alkaline silicate in solution, underwent a remarkable transformation. It was changed into a solid confusedly-crystallised substance. The crystals were in small prisms, which scratched glass. This substance was not acted upon by hydrochloric acid. It was a double silicate of alumina and alkali, having all the properties of felspar, and was mixed with a little crystallised quartz. Thus, then, you take this pulverulent amorphous stuff, china clay, and by exposing it to the action of hot water, such as we find existing in various parts of the world—thermal springs containing a little alkaline silicate in solution, you effect the transformation of the china clay into a perfectly solid, compact, felspathic rock. Thus, in nature, argillaceous beds may have been readily felspathised by the permeation of water containing alkaline silicate under great pressure, and at a high temperature. The quantity of water required for this purpose is very small—not greater even than that found mechanically mixed with the rocks themselves *in situ*. There is another point deserving of remark. The glass operated upon by Daubrée had acquired a decidedly slaty structure, cleaving easily into leaves so thin that more than ten could be distinguished in the thickness of one thousandth of a metre. It recalled, he says, the structure of certain crystalline slaty rocks.

As an excellent illustration of metamorphism which appears to have been effected by thermo-hydric action may be cited the observations of Daubrée, near Rothau, in the Vosges. Syenitic granite, as he terms it, has penetrated Devonian beds, which, even to the distance of several hundreds of metres from the point of contact, are entirely modified. In certain points the rock is wholly formed of a mixture of lamellar augite, epidote, and compact garnet, with some galena. In the middle of the rock formed of these silicates, Danbrée found numerous polypes perfectly well preserved. Even the cavities left by the partial disappearance of the calcareous substances of these polypes was studded over with crystals of the same mineral as formed the matrix. The most abundant was black hornblende, in elongated, perfectly defined crystals, penetrating occasionally into the crystals of quartz, as is frequently seen in the middle of rocks, having lost all traces of fossils. Grass-green garnet, moreover, occurs, completely recalling that of Monzoni, in the Tyrol, and of Drammen, in Norway. Large crystals of axinite were also discovered by Daubrée, of which the presence had not been previously recognised, under similar conditions, in fossiliferous rocks. I will now give you his *resumé*, translated as near as possible. He remarks :— "The organic remains so well preserved at Rothau deserve to be regarded as classical monuments of metamorphism. They teach us, in fact, that a rock incontestably of sedimentary origin is now formed of anhydrous and crystallised silicates, such as augite, hornblende, garnet, epidote, and axinite; and, further, that this rock has been profoundly transformed without notably softening, since the *délicatesses*" [as he terms them : we cannot find exactly the same word in English] "of the surface of the polypes are well preserved in it." Metamphorism of this kind explains how the angular edges of numerous fragments, which are very often met with in granites from the most different localities, should have been preserved. Danbrée insists especially upon the connection between the metamorphism of stratified beds and dislocation, and the connection of dislocation with the occurrence of thermal waters. All that you require is immense pressure at great depths and corresponding degrees of temperature. He has calculated that over three-quarters of the globe thermal waters cannot rise except by overcoming the pressure of the water of the ocean, which on the average may be taken at 200 atmospheres.

Another mode of metamorphism is by the removal of part of the constituents of a rock by the mechanical action of water. The washing out of argillaceous, ferruginous, or other mechanically-mixed matter from a sandstone rock, and the transformation of this into quartzite, which is regarded as a metamorphosed sandstone, is an instance of this kind of metamorphism. The blending together of the grains of quartz may be so intimate as to have obliterated the evidence of the original structure, and the rock might be supposed to have been deposited as such from water; but, according to Coquand, with attention, it is easy to discover rounded grains of quartz, and to establish the passage from sandstone into quartzite. Subsequent to the removal of foreign matter there may be agglutination of the grains by the deposition of dissolved silica.

There is metamorphism by the solvent action of liquids. This is a very important part of our subject. I may mention, as an example, water containing carbonic acid in solution. This solvent action takes place on a large scale upon the so-called igneous rocks containing silicates, which are slowly decomposed by water impregnated with carbonic acid. The matter dissolved out may be again deposited in various states of combination, as we have seen in a previous lecture. I spoke especially of the decomposition of silicate of lime by this means. I now just recur to it in order to bring it in as part of this series of metamorphic actions.

Metamorphism takes place by the deposition of matter from solution. Silicification is an example of this kind of metamorphism. At Kolmar, in Alsace, muschelkalk in contact with granite is changed into hornstone from the action of springs containing silica. The same is observed in Kentucky and Indiana on a great scale.

We have also a metamorphism by double decomposition from the action of aqueous solutions. This is a point which has been only very imperfectly investigated. You will remember that we examined some of the theories on this subject with reference to the formation of dolomite.

Metamorphism by the addition of water is another mode in which this phenomenon occurs. As an example of this I may mention that anhydrite—the anhydrous form of gypsum—may be seen at St. Gothard in every stage of conversion into gypsum. At Berry Head, near Torquay, I think I have observed something of the same kind in a vein of red hæmatite, or red iron ore. I got specimens of the red iron ore from above and below. Where it was being constantly washed by the water of the sea it appeared to be passing into brown oxide of iron.

There is also metamorphism by oxidation and hydration. Take the case of carbonate of protoxide of iron in our coal measures, which is converted into brown iron ore by exposure to the weathering action of air and moisture. This action must have prevailed over large areas. There is no doubt that those extensive deposits of brown ore in Northamptonshire have been produced in this way, having been originally carbonate of iron, which has been converted, by the conjoint action of air and moisture, into brown ore of which the deposits now consist.

Metamorphism is occasioned in some cases by volcanic exhalations. Amongst these exhalations I may mention steam, hydrochloric acid, carbonic acid, and sulphuretted hydrogen. We shall consider these more particularly in our next lecture. As an example of such metamorphism, I may mention obsidian, which is decomposed by the hydrochloric acid vapour, leaving a residue of white clay, the iron being dissolved out and washed away. There is a volcano in Java, the whole crater of which is filled with boiling mud, from which hydrochloric acid escapes. It is dangerous even to approach this volcano, in consequence of the changes produced by the action of the acid. We have already mentioned the production of gypsum in Iceland by the action of sulphurous acid on palagonite rock. We have sulphuretted hydrogen in mineral springs, and this doubtless has played an important part in the production of many metalliferous veins. The hydrogen of the gas becomes oxidised by the action of the air, and the sulphur is deposited. Is any sulphurous acid formed with or without the presence of carbonate of lime? If so, sulphite of lime would be produced, and would be afterwards changed into sulphate of lime. At Aix and in Tuscany there are springs containing sulphuretted hydrogen rising through limestone which is changed into gypsum in the vicinity of the springs.

The last observation I have to make relates to a point of great importance, which has been brought forth quite recently and very prominently by Bischoff. It is the change of volume consequent on the decomposition of igneous rocks by carbonic acid and water. We know that they have been derived from pre-existing rocks, and this change can only have been effected, or to a great extent, at all events, by carbonic acid. The decomposition of the silicates of these rocks has been effected mainly, without doubt, by the action of carbonic acid. Carbonates have been produced, and the silica has been separated. This action gives rise to an enormous difference of volume. We will take, for example, basalt, having a volume of 33·33. On weathering that basalt, and converting it, by the action of carbonic acid, into quartz, kaolin, carbonate of iron, carbonate of lime, carbonate of magnesia, carbonate of potash, and so on, that volume of 33·33 becomes 70·93. Now, imagine a great rock, consisting of silicates, thus decomposed, and converted into these substances—quartz, kaolin, and so on—by the action of carbonic acid, and see what a great increase of volume must have taken place. Probably this is an action which may have played an important part, at all events, in the conformation of land. One other consideration, and I have done. The decomposition of these rocks by carbonic acid involves the extraction of that gas from the atmosphere, and its fixation. To this subject Eblemen has called attention in a very prominent way. The conclusion is, that in ancient periods there must have been carbonic acid in the atmosphere to a much greater extent than at present, and that it must have been slowly removed. There is no doubt that it must have been a very influential geological agent.

NOTICES OF BOOKS.

The Scottish Black-rain Showers and Pumice-stone Shoals of the Years 1862 *and* 1863. By the Rev. JAMES RUST, A.M., Minister of Slains. Edinburgh: Blackwood and Sons. 1864.

TUESDAY, January 14, 1862, will be a day long remembered by the washerwomen and gudewives of Slains, a parish lying on the coast of Aberdeenshire. The weather for the fortnight previous had brought plenty of soft water for washing, but of necessity had been eminently unfavourable for drying. The morning of Tuesday, however, opened bright and clear, with a pleasant breeze from S.S.E., which promised well for the final success of laundry operations, and we may imagine the women "up in the morning airly," and soon the snow of well-washed linen covered the greens around the village.

But there was nae luck about the house upon that washing day. Later in the morning the estimable minister of the parish, looking out of the manse window, saw far out at sea a "large, dense, black, smoky, fearful-looking cloud" driving shorewards. As it came on it sent forth a heavy shower of rain, which—worse than a Scottish mist—proved a decided mystification. The water that fell was black as ink, and the consternation of the gudewives as they regarded the appearance of the linen on which they had bestowed so much soap and labour, may be more easily imagined than described.

Nor was the gudeman saved from all vexations. He wanted soft water to shave himself with, and the sooty mixture brought from the butt curdled and mottled, but obstinately refused to make a lather. It was unequivocally acid, and had moreover a sulphurous smell; altogether it seemed clear that the Prince of Darkness must have been at work in the parish of Slains that day.

But the black rain was not the only startling phenomenon. Immediately after it fell the sea floated to land, and left stranded along the shore, vast quantities of pumice-stone, some fragments of which weighed as much as half a pound.

Whence could these and the soot and sulphur have come? That is the question which the Rev. Mr. Rust sits himself down to answer, and after investigating several theories propounded, finally connects the phenomena with an eruption of Vesuvius which happened two days before they occurred. To go further into the matter would be to deprive our readers of some of the pleasure of reading a well-written, amusing, and instructive little book, to which, therefore, we refer them for the full narrative and, to our mind, conclusive reasoning of the author.

Annalen der Chemie und Pharmacie. June, 1864.

The journal opens with a paper by Heintz "*On Diglycolic Acid,*" the conclusion arrived at being that the constitution of this body is best expressed by the formula—

$$\left.\begin{array}{c}\left.\begin{array}{l}C_2H_2\Theta\\ \left.\begin{array}{r}C_2H_2\Theta\\ H\end{array}\right\}\Theta\end{array}\right\}\Theta\\ H\end{array}\right\}\Theta$$

"*A Contribution to the Knowledge of Coniine,*" by Wertheim, details an elaborate determination of the vapour density of *Azoconhydrin* $C_8H_{16}N_2\Theta$, and also the properties of *Conylen*, and some of its derivatives—bodies of small interest to our readers.

Translations of papers by Dr. Stenhouse "*On Nitro-Erythroglucin*" and "*On Munjeet*" follow.

An account of "*Some Experiments on Vegetation,*" by Dr. Stohmann, succeeds, the results of which show that maize is a much more exhausting crop than beans, and that after a maize crop you may safely calculate on a good yield of beans; and further, that from a soil from which you can reap no maize you may gather a rich crop of beans.

Papers by H. Hlasiwetz and Barth "*On New Products of the Decomposition of Guaiacum Resin,*" and on a new body homologous with orcin and obtained from galbanum, we have referred to before.

Dr. Frankland's paper "*On the Combustion of Iron in Compressed Oxygen*" is also translated. The only other paper we need mention is a short one on the properties of cuprous chloride. This salt, it is well known, darkens when exposed to light, in consequence, says the author of this paper, of the formation of an oxysubchloride. The author gives an easy method of preparing cuprous chloride, which consists in dissolving equal equivalents of sulphate of copper and common salt and passing sulphurous acid through the solution. The cuprous chloride separates out as a white crystalline powder, which must be washed by decantation with aqueous sulphurous acid.

The Ophthalmic Review: a Quarterly Journal of Ophthalmic Surgery and Science. Edited by J. Z. Laurence and T. Windsor. No. 2. London: Hardwicke.

"One of the chief features in the recent progress of Ophthalmic Surgery," says one of the editors in a paper "On some Ophthalmic Instruments," "is its gradual tendency to assume the characters of the more exact sciences," which is, unhappily, more than can be said of any other branch of medical science. The object of the *Ophthalmic Review* is to promote this gradual tendency, and it deserves every success.

Poggendorff's Annalen der Physik und Chemie. No. 6. 1864.

The chemical papers in this number are confined to a short abstract of Mr. Robbins' paper "*On Oxygennesis,*" and another "*On the Relative Atomic Volume of Undecomposed Bodies,*" by P. Kremers.

The Retrospect of Medicine, &c., &c. Edited by W. Braithwaite, M.D., and James Braithwaite, M.D. Vol. xlix. January to June, 1864. London: Simpkin, Marshall, and Co. 1864.

We may content ourselves with announcing the punctual issue of this extremely useful serial.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1533. Wilhelm August Ahegg, Westminster Palace Hotel, Victoria Street, Westminster, "Improvements in apparatus for distilling spirituous liquors."—A communication from Carl Falkman, St. Petersburg, Russia.

1538. William John Pughsley, Christ Church, Monmouthshire, "Improvements in obtaining sulphuric acid from the refuse 'pickle' used in tin-plate works, and also from sulphate of iron or green copperas."

1543. Thomas Ogden Dixon, Steeton-in-Craven, Yorkshire, "Improvements in stoppers for bottles, jars, and similar articles, and in means or apparatus for withdrawing such stoppers from bottles, jars, and similar articles."

1545. James Forbes, Old Ford, Bow, Middlesex, "Improvements in the means of, and apparatus for, manufacturing sulphate of ammonia and sulphuric acid."—Petitions recorded June 21, 1864.

1375. Frederick Oldfield Ward, Hertford Street, May Fair, Middlesex, "Improvements in processes and apparatus for treating alkaliferous minerals to obtain alkalies, alkaline salts, alumina, and accessory products."—Petition recorded June 2, 1864.

1523. Richard Jones, Botolph Lane, Eastcheap, "An improved method of preserving animal and vegetable substances."—Petition recorded June 20, 1864.

1571. Joseph Tirat, Russell Place, Fitzroy Square, Middlesex, "A new voltaic apparatus for the relief of hernia in all its forms and stages."

1577. Archibald Turner, Leicester, and James Clark, Manchester, "Improved machinery or apparatus for vulcanising India-rubber, which machinery or apparatus is peculiarly adapted for vulcanising by the cold process, or without the application of heat."

1580. James Hinks and Joseph Hinks, Birmingham, Warwickshire, "Improvements in lamps for burning paraffin oil and other volatile liquid hydrocarbons."—Petitions recorded June 23, 1864.

1587. George Timothy Sims and John Pendley, Shadwell, Middlesex, "A new composition for preventing and removing incrustation in steam and other boilers."—Petition recorded June 24, 1864.

1599. Benjamin Franklin Stevens, Trafalgar Square, Middlesex, "Improvements in the application of petroleum, coal-oil, and other similar substances, to the purposes of heating, lighting, and obtaining motive power, and in the apparatus employed therein."—A communication from Simon Stevens, New York, U.S.A.—Petition recorded June 25, 1864.

1618.—John Augustus Houck and Thomas Hill, Manchester, Lancashire, "An improved varnish for paper, wood, metals, or other substances, which invention is also applicable to paper and calico printing."—Petition recorded June 28, 1864.

1655. William Edward Gedge, Wellington-street, Strand, Middlesex, "Improvements in the firework known as Roman candle."—A communication from Henri Frédéric Favre-Couvel, Nantes, France.—Petition recorded July 4, 1864.

1669. George Phillips, Holborn Hill, London, "Improvements in the manufacture of aniline colours."—Petition recorded July 5, 1864.

Notices to Proceed.

507. William Henry Mellor, Liverpool, Lancashire, "An improved apparatus to be used when fermenting malt liquors in casks or other like close vessels."—Petition recorded March 1, 1864.

563. Thomas Gray, Mitcham, Surrey, "Improvements in the treatment of 'jute' and 'jute' cuttings."—Petition recorded March 5, 1864.

594. Nathan Thompson, Abbey Gardens, St. John's Wood, Middlesex, "Improvements in apparatus for stopping bottles, jars, and other vessels."

668. James Carrick, George Square, Glasgow, Lanarkshire, "Improvements in apparatus for inhaling, breathing, and respiratory purposes."—Petition recorded March 16, 1864.

827. Richard John Edwards, Bow, Middlesex, "Improvements in the mode of toughening papers and other substances to render them suitable for the application of abrasive substances and for other purposes, and in apparatus used in such manufacture."—Petition recorded April 2, 1864.

1515. Thomas Agnew, jun., Manchester, Lancashire, "Certain improvements in apparatus for coating or covering moulded or other surfaces with certain composition or material."—Petition recorded June 18, 1864.

1525. Richard Smith and Christian Sieberg, Glasgow, Lanarkshire, N.B., "Improvements in obtaining colouring matters."—Petition recorded June 20, 1864.

CORRESPONDENCE.

Continental Science.

Paris, July 21, 1864.

Agricultural machinery, thanks to the far-sightedness of the present Emperor, is making great way in the provinces. The *Journal d'Agriculture Pratique* announces a grand trial of reaping machines to take place at Amiens, under the auspices of the Agricultural Committee of that city, towards the end of the month, so that the farmers may see what to buy for the coming harvest. Prizes in money and medals will be given.

Your readers, who, like myself, tasted Chinese mutton at one of the late banquets of the British Acclimatisation Society, will be glad to hear the Chinese ram and ewe that were presented to the French Acclimatisation Society last year are increasing and multiplying. Last July the ewe dropped four lambs. She suckled three, and the remaining one, to whom she took a most unaccountable dislike, for it was one of the prettiest lambkins ever seen, had to be brought up by hand. Last January she dropped three more, making seven altogether, all of whom are thriving. The mother is again in that condition in which Chinese ewes like to be who love their mandarins, and seems in no way to have suffered from being in a state of confinement, or, rather, I should say, captivity, for fear of being misunderstood when speaking of these very prolific creatures. Besides their fecundity, they possess the advantage of making most delicious meat, and growing wool of great fineness and length of staple.

M. Nobel announces that by damping mining powder with nitroglycerin its explosive power is trebled, and the noise of the explosion much less than when ordinary powder is used.

In order to increase still more the constancy of the Daniel's battery, Father Secchi advises the use of fine sand or of powdered sulphur in the porous cell. He accounts for its action by supposing that when the ordinary liquid alone is used there is greater liability to local action taking place upon the zinc. In a battery, the circuit of which is closed for two minutes every quarter of an hour, the learned Father has used an ordinary piece of commercial sheet zinc, half a millimetre in thickness, which has continued in action for more than six months, without showing the least sign of corrosion. For large elements instead of porous diaphragms he uses bags made of coarse linen cloth, well anointed with a luting of flour and lime. Those who have experienced the difficulty of procuring large porous cells would do well to test these contrivances.

The Academy of Sciences at Vienna have offered a prize of 200 ducats (about 90*l.*) for the best research on the movements of the fixed stars. The papers are to be sent in before December 31, 1865.

The new Astronomical Society, founded last year at Heidelberg, is doing good work. Some dozen of its most eminent members are computing the disturbances which have taken place in the movements of Mercury, Venus, Mars, Jupiter, Saturn, and Uranus. Some of them go back as far as 1770. The asteroids, too, are receiving great attention from a certain number of members, each taking a planet under his observation and observing its motions periodically. The society is essentially international in its character, and numbers amongst its members not only German, but English, French, Italian, and Russian astronomers. Unlike M. Leverrier's new society, the Heidelberg Society rejects the principle of giving prizes for competitive papers.

The experiments made by several leading sericiculturists on the eggs of the Japanese variety of silk-worms, which were brought by M. Berlandia, have for the most part been successful. Although a large number of the eggs were infertile, yet those that did hatch produced healthy worms, most of which have now attained to the cocoon stage. The experimenters in these foreigners anticipate a large crop of eggs for next year. If the sericiculturists can succeed in introducing the Japanese insect into France it will be of the utmost importance, for the spread of disease amongst the French worms has been fearful of late years.

A fine crystal of the raw Elban mineral pollux has just been presented to the mineralogical department of the museum of the *Ecole des Mines.* This rare mineral is interesting as, according to the researches of M. Pisani, it contains a very large proportion of cæsium. Up to the time it was examined by M. Pisani, the cæsium was always supposed to be potassium or sodium. Those who possess good collections of minerals supposed to contain these two alkaline metals, should set to work and examine them by the aid of the spectroscope. The trouble taken would doubtless be rewarded by the discovery of many other minerals besides pollux containing cæsium or rubidium, hitherto taken for potash and soda.

The Duke de Luynes and his companions have just returned from visiting the Holy Land and the Dead Sea, and have brought home with them a large number of specimens and observations of the greatest interest. It strikes me that this is a much better use to which to apply ducal revenues than cultivating the friendship of firemen and engine-drivers.

A Case of Dialysation.

To the Editor of the Chemical News.

Sir,—In preparing solutions of vegetable acids in a large manufactory lately where, as usual, the solutions are separated from an insoluble residue which is washed until tasteless, I found in one of the filters an impossibility of accomplishing this, the acid taste remaining, although water freely percolated through the mass; and on closer examination I found that the filtered liquor, which originally contained only a very small percentage of sulphuric acid, now consisted almost entirely of it, the crystallisable acid having been kept back by the precipitate, which in this case seems to have acted as a dialyser. I may further add that as soon as there was more space allowed below the false bottom, so that the liquor could not remain at all in contact with the precipitate, this effect ceased. Thinking this fact may be of interest to some of your readers,

I am, &c., Chemicus.

Solubility of Gold.

To the Editor of the Chemical News.

Sir,—While examining an alloy of silver and gold for the purpose of ascertaining the percentage of gold that it contained, I found, to my surprise, that a mixture of sulphuric acid and nitric acid dissolves gold to a considerable extent. This fact seemed to be of some importance, and being unaware of a similar observation having been hitherto made, I send you a note of it.

I am, &c.,
A. Reynolds.

MISCELLANEOUS.

SIMPSON *v.* HOLLIDAY.

This was a trial, without a jury, before Vice-Chancellor Page Wood. Substantially the case was the same as that of Simpson *v.* Wilson, tried before Lord Chief Justice Cockburn, in December, 1862, and fully reported in vol. vii. of the Chemical News. We need now, therefore, only recapitulate the leading points in the evidence.

The patent in dispute is that of Medlock for producing Magenta colour by operating on aniline with *dry* arsenic acid, and the case turns upon the meaning of the word *dry* in the specification. By *dry* arsenic acid is it meant the anhydrous acid containing absolutely no water, or is it the hydrated acid which is dry to the senses? The latter is the meaning contended for by the plaintiff, and the former by the defendant, who urges that, inasmuch as that anhydrous acid will not produce the colour, the patent is void.

The first witness called was Mr. E. C. Nicholson, one of the plaintiffs, who, in reply to questions by Mr. Grove, stated that he had made and sold arsenic acid before the date of Medlock's patent. He sold it in the dry state. The term dry is constantly applied to bodies which contain water; what is called dry lime contains 39 per cent. of water; dry alum may contain 50 per cent. of water. He supplied Dr. Medlock with the dry commercial arsenic acid. In making the colour he preferred to use a solution of arsenic acid, and to heat the mixture until the water of solution was driven off, and only the water of hydration left. No colour is produced as long as water is present. In his judgment there was no chemical difference between producing the colour by using water and boiling it off, and making it in closed vessels with dry arsenic acid. The chemical reaction is the same in both cases. The object of specifying dry acid was to get at something like a proper proportion of acid to use. It is a better indication of proportion.

In cross-examination by Mr. Hindmersh, the witness stated that the process given in several books for making arsenic acid would produce the dry but not the anhydrous acid. In order to obtain the colour it was necessary to form arseniate of aniline, which could not be formed without water. Dry arsenic acid with 14 per cent. of water would probably unite with an equivalent of aniline to form arseniate. Practically he used 75 per cent. of solid arsenic acid and 25 per cent. water, which would really amount to 32 per cent. of water, and 68 of anhydrous acid. The use of water is entirely mechanical; therefore, within certain limits, the larger the quantity of water you employ, the better combination with aniline you get. 25 per cent. of water answers very nicely. Dry arsenic acid will combine with aniline; anhydrous will not. If you mix anhydrous acid, aniline, and water, the acid must first combine with the water before arseniate of aniline is formed. No colour will be produced until the water of solution has been driven off, and a temperature of about 320° is reached. A mixture of arsenic acid with 25 per cent. of water and aniline, heated in a sealed tube to 370°, produced very little colour, showing that it is necessary to get rid of the water.

Re-examined by Mr. Grove: The proportions we use are six gallons of aniline to four gallons of a solution of arsenic acid containing 25 per cent., which will yield about 62 lbs. of arsenic acid, and 60 lbs. of aniline. The exact proportions are not important, so long as you have an excess of aniline, that is a *sine qua non*.

Dr. Hofmann was next examined. He stated that the word "dry" had been loosely employed by chemists, sometimes to indicate anhydrous materials, and at other times hydrated bodies which were dry to the touch and eye. This case will introduce greater precision into the language of chemical manuals. Whether the word "dry" means anhydrous or not must be judged from the context.

Dr. Odling examined: He said he was not misled by the use of the word "dry" in the specification. In the majority of instances when the word "dry" is used in chemical books, it simply means dry to the touch.

The remainder of the evidence for the plaintiffs is really but a repetition of the foregoing statements. On the second day an experiment was made in court to prove the colour produced in a sealed tube was very small in comparison with that formed when aniline and dry arsenic acid are heated in the open air.

For the defendant, Dr. W. A. Miller was first examined. He stated that in his own book on Chemistry "dry" arsenic acid is spoken of as an anhydrous substance. Before these trials, dry and anhydrous were used as convertible terms with reference to arsenic acid. He was familiar with arsenic acid in the anhydrous form before the trial. No colour is produced by the action of anhydrous arsenic acid upon anhydrous aniline. But colour is produced when aniline and a solution of arsenic acid are heated in a sealed tube.

Mr. D. Campbell, Drs. Taylor, Letheby, and Wanklyn gave similar testimony. Evidence was also given by manufacturing chemists who had supplied or had been applied to for fused and vitrified arsenic acid by Messrs. Hands and Son, of Coventry, who held the first assignment of Medlock's patent.

The hearing of the case lasted six days.

On the 15th the learned Vice-Chancellor gave judgment in favour of the plaintiff; but we understand that the defendant has signified his intention to appeal.

ANSWERS TO CORRESPONDENTS.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

⁂ All *Editorial Communications* are to be addressed to the Editor and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E C.

Vol. IX. of the Chemical News, containing a copious Index, is now ready, price 10s. 6d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. X. commenced on July 2, 1864, and will be complete in 26 numbers.

A Reader.—We are not aware that the substance ormulated has ever been prepared.

Dr. L. Schad.—It might answer our correspondent's purpose better, perhaps, if the mistake were not mentioned.

M. O.—There are two volumes of the *Philosophical Magazine* every year, beginning in January and July, price 17s. 6d. per vol. *Repertoire de Chimie, &c.*, one vol. a-year, beginning in January. For price ask foreign bookseller.

A Young Chemist.—1. Burn with soda lime, and determine ammonia by standard acid as described in the manual. 2. The smell is proper to the oil, and could not be removed without destroying it.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on Oxygen, by Dr. G. Meissner.

(*Continued from page* 11.)

Many very strong saline solutions and some dry substances have the power of removing for a time the atmizone cloud, without, however, destroying its power of reproduction. So, for example, act concentrated solutions of the chlorides of sodium, potassium, and barium, iodide of potassium, sulphate of magnesia, and caustic potash. These solutions produce their effect only by their power of retaining moisture. Dilute solutions of the same salts do not affect the cloud, concentrated destroy it by retaining the water.

The question that next arises is, How much water does the cloud contain? and by comparing the capacity for water of a stream of unelectrised air with that of an electrised stream, by passing an equal volume, in the same time and at the same temperature, through a chloride of calcium tube, the author found that the increase of weight in the latter case was nearly double that in the former.

Atmizone, in the presence of a sufficient amount of water, and in the course of half or three-quarters of an hour, gradually loses its peculiar properties, even when the external conditions are not at all changed. During this time it enters into no new combinations, but only reverts to the condition of ordinary oxygen.

That the attraction of atmizone for water gradually becomes weaker and weaker, is shown not only by the fact that the first attracted cloud-water is gradually precipitated, but by another and most striking experiment. There are fluids containing water from which the atmizone, immediately after its formation, and before it has had the opportunity of becoming saturated, can extract water, while the same fluid later not only gives up no water, but on its part abstracts the moisture. If a deozonised electrised stream be first passed through alcohol (80 per cent.), afterwards through water, once more through strong alcohol, and then again through water, there will be seen on the first alcohol a thin cloud, which will last as long as the experiment is continued; on the water in the second receiver the air will be strongly cloudy, but in the second alcohol receiver the cloud will be completely lost, and the air will pass in the second water receiver quite transparent, but will again appear on the surface of the water. Thus the first alcohol must communicate some water, while the second withdraws it.

The behaviour of concentrated saline solutions is no doubt similar, and the gradual alteration of the atmizone is also noticed when the deozonised air is passed through a succession of vessels of water.

From the foregoing it is seen that the atmizone begins to change as soon as it comes to rest with the vapour of water, and therefore it follows as a rule that the series of vessels through which we pass the electrised air in our experiments on this body, must be of the smallest possible dimensions, so that the mass of air may not be detained long in part of the passage. The rapidity of the stream of air, the author found, must also be regulated, and he found in his experiments that he obtained the best results by passing four or five litres through the apparatus in an hour. The vessels in which the deozonisation of the air was effected, and those in which the subsequent saturation with aqueous vapour, and the experiments on the action of atmizone took place, had a capacity of from 40 to 60 cc., except in cases when larger dimensions were required.

We have hitherto been dealing only with moist, or with moisture-saturated atmizone, let us now see how the dry behaves in the course of time. If we dry the stream of air (previously deozonised by passing through a concentrated solution of iodide of potassium) by passing it through a chloride of calcium tube or sulphuric acid, and fill dry glass flasks with the mixture of dry atmizone and air, we can study the behaviour of the atmizone by opening the flasks from time to time, and shaking it with a little water. It will then be seen that the first opened will form a strong cloud; but it will be observed that the cloud-forming power is gradually lost in the later-opened flasks, and after a certain period is completely absent. The change proceeds more slowly with the dry than the moist atmizone, and takes place only in an hour or an hour and a half.

Under the same conditions in which atmizone so quickly disappears without entering into any chemical combination, ozone is, on the contrary, very permanent. If a capacious flask containing a little water be filled with electrised but not deozonised air, and well closed so that the air is only in contact with glass and pure water, the atmizone disappears in a short time. The greater part of the ozone, however, remains unchanged, and its presence in the flask may be proved after several months. That some ozone disappears is beyond doubt; but the diminution is not considerable; the smell retains its full intensity, and the oxidising action is as energetic after months as it was at first.

(To be continued.)

Analysis of the Mineral Pollux of the Island of Elba, by M. F. Pisani.

Pollux is a very rare mineral, of which there exists only the incomplete analysis of Plattner, in which he found chiefly silica, alumina, potash, and soda.

M. Pisani, having at his disposal a beautiful specimen of this substance, has made a complete and interesting analysis, finding in it an abundance of cæsium, and this is the first time a mineral has been proved to contain this metal as a really constituent part.

The density of this specimen is 2·9; its lustre glassy and colourless; its hardness about 6·5. On analysis it gave,—

Silica	44·03
Alumina	15·97
Oxide of iron	0·68
Lime	0·68
Oxide of cæsium (Cs = 133) (traces of potash).	34·07
Soda (with a little lithium)	3·88
Water	2·40

The rose-coloured lepidolite of Elba contains almost as much rubidium as that of Rozena, and about a fourth as much cæsium as rubidium.—*Bulletin de la Société Chimique*, vi., 456, 1864.

On the Employment of Fluohydrate of Fluoride of Potassium in Analysis, by Wolcott Gibbs, *M.D., Rumford Professor in Harvard University.*

(*Continued from page* 17.)

Hyponiobic Acid.—I am indebted to the kindness of Professor B. Silliman, jun., for a liberal supply of columbite from Middleton, Connecticut. Mr. F. W. Tustin has found that the finely-pulverised mineral treated with a solution of three times its weight of fluohydrate of potassium is almost completely resolved during the mere process of evaporation to dryness. The dry white powder thus obtained by fusion in a platinum crucible gives a beautiful rose-coloured mass, which is easily separated from the crucible, and which, in a moist atmosphere, falls to a crystalline powder. On boiling with water acidulated with fluohydric acid a clear solution is obtained, from which, on cooling, hypo-fluoniobate of potassium separates in colourless crystals. By repeated crystallisation, the salt may be obtained free from iron and manganese, but containing an excess of fluoride of potassium. It is better, however, to pass a current of sulphydric acid gas through the solution to remove traces of tin and tungsten, and reduce the iron to protofluoride, and afterwards to evaporate and crystallise.

When the object in view is simply to prepare perfectly pure hypofluoniobate of potassium, it is better to fuse one part by weight of columbite with two of fluohydrate of potassium. The fused mass has then a greenish tint. It must be rubbed to very fine powder before boiling with water acidulated with fluohydric acid. After passing sulphydric acid gas through the solution and filtering, the hypo-fluoniobate crystallises in colourless acicular crystals, which must be purified by repeated crystallisation. The salt is much more soluble in hot than in cold water. In this process a considerable quantity of fluosilicate of potassium, fluoride of calcium, quartz, and other impurities, usually remain upon the filter, with the sulphides of tin and tungsten. The difficulty in this process consists in separating the iron when, as in the mineral columbite, this is present in comparatively large quantity. In this case very large platinum or silver vessels, and numerous recrystallisations, become necessary. It is better, therefore, in preparing large quantities of pure hyponiobic acid, to fuse with fluohydrate of potassium, dissolve the fused mass in water as before, and filter to separate quartz, fluosilicate of potassium, and fluoride of calcium; evaporate the solution to dryness, and heat with pure sulphuric acid until the whole of the fluorine is expelled. By diluting with water and boiling, the whole of the hyponiobic acid is precipitated. If, after the precipitation, Rochelle salt is added, and the whole is boiled, the hyponiobic acid will be almost completely free from iron, manganese, tungsten, and tin. After thorough washing, it may be again fused with fluohydrate of potassium, and the double fluoride obtained perfectly pure by re-crystallisation.

Chromic Iron Ore.—Mr. P. C. Dubois has found that the finely-pulverised ore may be completely resolved by fusing it at a red heat for ten or fifteen minutes over a blast lamp with four or five times its weight of fluohydrate of potassium. The fused mass has a clear green colour. By treating this with sulphuric acid until the whole of the fluorine is expelled, and then adding water, the chromium iron and aluminium are completely dissolved as sesqui-salts. Perhaps the easiest method of separation is the following:—To the solution an excess of caustic soda is added, after which, without filtering, chlorine gas is to be passed through until the sesquioxide of chromium is converted into chromic acid. The solution is then to be heated to expel excess of chlorine, nitric acid added in slight excess, and the sesquioxide of iron and alumina precipitated by ammonia. To the filtrate acetic acid is to added in small excess; after which the chromic and sulphuric acids may be precipitated together by acetate of lead. The precipitate, after washing, is to be boiled with chlorhydric acid and alcohol, the lead separated as chloride, and the chromium determined in the usual manner as sesquioxide. This method gives a complete separation, even when magnesia and nickel are present in the ore.

From what has been said it will appear that fluohydrate of potassium possesses peculiar advantages in resolving those minerals which contain metallic acids of the type RO_2, or hyponiobic acid. The salt is easily prepared in a state of purity, and may be preserved in vessels of lead or of vulcanised india-rubber or gutta-percha.—*American Journal of Science*, vol. xxxvii., p. 346.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 29.

"*On the Classification of the Elements in relation to their Atomicities,*" *by Professor* ALEXANDER W. WILLIAMSON, *F.R.S., President of the Chemical Society, &c.*

THE speaker proposed to bring under the consideration of the members some of the chemical grounds for doubling the atomic weights of all the metals in Gerhardt's system of atomic weights, excepting the alkali metals, silver, gold, boron, and the metals of the nitrogen series. A change which has been proposed mainly on physical grounds by Cannizzaro, and which seems to be obtaining the approbation of more and more chemists.

TABLES OF ATOMIC WEIGHTS.

1st Class of Elements, which only furnishes an even number of atoms to each Molecule:—

Fl =	19	H =	1	N =	14
Cl	35·5	Li	7	P	31
Br	80	Na	23	As	75
I	127	K	39	Sb	122
		Rb	85	Bi	210
		Cs	133	B	11
		Tl	203	Au	196
		Ag	108		

2nd Class of Elements, which sometimes furnishes an odd, sometimes an even number of atoms to one Molecule.

O =	16	C =	12	G =	9
S	32	Si	28	Yt	64
Se	79·5	Ti	50	Ce	92
Te	129	Sn	118	La	92
Ca	40	Mo	96	Dy	96
Sr	87·5	V	137	U	120
Ba	137	W	184	Zr	89·5
Pb	207	Pt	197	Ta	138
Mg	24	Ir	197	Cb	195
Zn	65	Os	199	Th	238
Cd	112	Ro	104		
Hg	200	Ru	104		
Al	27·5	Pd	106·5		
Fe	56				
Cr	52·5				
Mn	55				
Co	58·5				
Ni	58·5				
Cu	63·5				

It is now about twenty years since Gerhardt drew attention to the error of the molecular weights, or equivalent weights, as he called them, which represented water as consisting of one atom of oxygen and one of hydrogen, and proposed to double the atomic weights of oxygen and of carbon.

If Gerhardt had taken Berzelius's atomic weights and, while translating them into the hydrogen scale, had halved the atomic weights of the alkali metals and boron, he would have given us at once the system which we now adopt, saving the rectification of a few formulæ, such as that of silver and oxide of uranium, &c.; whereas by merely doubling oxygen, sulphur, selenium, and carbon, in the then existing system of atomic weights in the hydrogen scale, he really introduced a system in which there are between 30 and 40 atomic weights to correct, in lieu of one which needed only five or six such corrections. It would be unreasonable to apply this fact in any degree to the disparagement of Gerhardt's work. It only shows how tortuous is the road which leads to truth.

The discussion of the question involves chiefly the consideration of the classification of the elements under the respective heads of chlorine and of oxygen.

The first tribe containing those elements of which an atom combines with one atom of hydrogen or chlorine, or with three or with five, &c., whilst the second tribe contains elements of which each atom combines with two atoms of chlorine, or other monads, or with four, or six, &c. The speaker did not, however, recommend that the two great classes of elements he thus distinguished from one another, for our chief evidence of atomic weights is derived from the study of the molecular weights of compounds, and the molecule is the unit to which results must be referred.

The first class is best described as furnishing only an even number of atoms to each molecule, whereas the second class sometimes furnishes an even, sometimes an uneven, number of atoms to one molecule. The process of classifying the elements has followed the very natural order of establishing a certain number of well-defined families, which were subsequently connected together by erratic members, which occasionally left their usual place to go over to some neighbouring family. Chlorine, bromine, and iodine have long been acknowledged to constitute a natural family; and there are some, though hardly sufficient, reasons for placing fluorine at its head. The three elements have the same vapour volume as hydrogen in the free state, and we accordingly represent their respective molecules as Cl_2,Br_2,I_2, corresponding to $H_2 = 2$ vols. They form hydrides of similar composition, and analogous properties, and of the same vapour volume. Their compounds with most metals are analogous, and have the same atomic heat and general crystalline form. Their corresponding oxygen acids also exhibit considerable analogy.

With organic radicals they form neutral ethers, like ClC_2H_5, ClC_2H_3O, and no acid ethers. So that when a molecule of alcohol or of acetic acid is replaced by chlorine, two atoms of chlorine take the place of one atom of oxygen, and give rise to a molecule of chloride of ethyle and a molecule of hydrochloric acid. They replace hydrogen atom for atom, taking out one, two, or three atoms, &c., according to circumstances. Their hydrogen compounds are all monobasic acids; for if, in a given quantity of hydrochloric or hydrobromic or hydriodic acid, we replace part only of the hydrogen by potassium, we get at once a neutral salt mixed with the remaining acid, which is undecomposed, and never an acid salt of the alkalies. Fluorine in this respect exhibits an anomaly which tends to remove it from this family to a biatomic one. For the acid fluoride of potassium is a well-defined compound of considerable stability, of which the existence points to the atomic weight 38 for fluorine, and the formula H_2F for hydrofluoric acid. Hydrofluoric acid, moreover, combines with various metallic fluorides—such as fluoride of silicon and fluoride of boron; and there are double fluorides of aluminium, &c., with alkaline fluorides, both well known and easily formed.

Similar double salts are, however, formed by chlorine; for instance, terchloride of gold combines with a molecule of hydrochloric acid, or of an alkaline chloride. Tetrachloride of platinum combines with two molecules of hydrochloric acid or of chloride of potassium, &c.

It is not possible to reconcile the constitution of these and similar bodies with one another and with the simpler compounds of chlorine, by any theory representing it as polyatomic, and as holding together the metallic atoms in these salts in virtue of its polyatomic character. On the other hand, hydrochloric acid and metallic chlorides of opposite properties cannot be assumed to be incapable of uniting with one another, while it is well known that oxides of basylous properties unite with those of chlorous properties. Hydrochloric acid unites with ammonia, and we do admit that the two molecules are bound together into one by a chemical force of combination, and not by any tetratomic character of the hydrogen; and HCl or KCl combines, with SO_3 by a similar force.

Again: oxygen, sulphur, selenium, and tellurium are admitted to be truly analogous elements, for the parallelism of oxygen salts, and sulphur salts, affords abundant proof of the analogy of oxygen and sulphur, and the molecular volume of sulphur and selenium is found by Deville to agree at high temperatures with that of oxygen.

The elements selenium and tellurium form acids analogous to sulphurous and sulphuric acids respectively. When combined with organic radicals they form compounds of the same molecular volume in the form of vapour; and when any of them, such as oxygen, replaces hydrogen in an organic body, it takes out two atoms of hydrogen at a time, replacing each couple by one atom of oxygen, as in the formation of acetic acid from alcohol.

When we partially decompose water by potassium we get hydrate of potash formed, which is a molecule of water, from which half the hydrogen is expelled and replaced by potassium, and a second atom of potassium is required to displace the remaining hydrogen.

If we compare any proto-chloride with a corresponding oxide, either of a metal or organic radical, we find that the molecule of the oxide contains twice as many atoms of the metal or radical as the chloride, and that one atom from the oxygen family is equivalent to two atoms from the chlorine family.

When oxygen in alcohol is replaced by sulphur, no breaking up into sulphide of ethyle and sulphide of hydrogen takes place, as when the oxygen is replaced by chlorine or bromine.

Among the best known compounds there are several of which one atom combines, like an atom of oxygen or of sulphur, with two atoms like hydrogen or chlorine. This carbonic oxide, sulphurous acid, and olefiant gas are capable of combining in the proportion of one atom of the radical with two atoms of chlorine, forming the compound $COCl_2$ phosgene, So_2Cl_2 chloro-sulphuric acid, and $C_2H_4Cl_2$ Dutch liquid; and these molecules have the same vapour volume as steam OH_2. But in the free state the radicals have a vapour volume double as great as the equivalent quantity of oxygen, the atoms CO,SO_2,C_2H_4 being as bulky as O_2, so that whereas the molecule of oxygen and of sulphur consists of two atoms, that of carbonic oxide consists of one atom only, so also the molecule of sulphurous acid and of olefiant gas.

Another family of very marked characteristics is that consisting of N,P,As,Sb,Bi, each member of which combines with three atoms of hydrogen or of ethyle (C_2H_5), forming basic compounds analogous to ammonia. Their analogy in chemical reactions is also well known, as each of them forms an oxide corresponding to nitrous acid, and another corresponding to nitric acid.

The sulphides of arsenic and antimony are notorious for their great resemblance, and that of arsenious and antimonious acid is scarcely less striking. It even extends to isomorphism of their corresponding salts.

The atomic heat of the four last terms of the series is also very nearly the same, whilst that of nitrogen (examined of course as a gas) is considerably less. Then the molecule of phosphorus and of arsenic consists of four atoms, whilst that of nitrogen consists only of two, showing a variety of constitution which is by no means to be wondered at, when we recollect that these elements are not uniformly triatomic, but sometimes monatomic, pentatomic, &c., so that the molecule of free nitrogen consists of two monatomic atoms, or two triatomic, whilst the molecule of phosphorus and of arsenic is formed on the ammonia type of one triatomic atom and three monatomic atoms.

Another family may, perhaps, be made up of carbon and silicon, both of which form volatile tetrachlorides, and are sometimes biatomic, sometimes tetratomic in their acids.

Among metals, lithium, sodium, potassium, and probably also the new metals rubidium, cæsium, and thallium, have many important points of resemblance which show them to be monatomic. They replace hydrogen atom for atom, and form with many bibasic acids both normal and acid salts. Their chlorides form with tetrachloride of platinum analogous double salts, and their sulphates form, with sulphate of alumina, &c., those well-characterised salts called alums. They do not form basic salts (unless when triatomic, like thallium). They have nearly the same atomic heat.

Silver is remarkable for several of the properties which we have noticed in the alkali metals. It is eminently monatomic, and disinclined to form basic salts. Its atomic heat also shows it to be monatomic. It appears to form an alum, and its sulphate has a great resemblance of form with the anhydrous sulphate of soda.

Gold also must, from its specific heat and the constitution of its two chlorides, be classed among the metals which are monatomic or triatomic. Boron is evidently triatomic in its best known compounds, as proved by the terchloride and ethylide.

Among metals with strongly basylous properties, Ca, Sr, Ba, Pb, are connected by very close analogies. The general resemblance of their sulphates and carbonates, and the isomorphism of most of them, are too well known to need mention.

But lead has been obtained in combination with ethyle, and the compound $Pb(C_2H_5)_4$ which corresponds to binoxide of lead, in which the two atoms of oxygen are replaced by four atoms of ethyle, and the compound $Pb(C_2H_5)_3Cl$ proves beyond a doubt that the metal is there tetrabasic.

Again: lead is pre-eminent for its tendency to form basic salts even with purely monatomic chlorous elements and radicals. Thus ordinary nitrate of lead, when warmed in aqueous solution with ceruse, expels carbonic acid from that compound, and forms the well-known and crystallisable basic nitrate—

$$\mathrm{Pb}\left\{\begin{matrix}NO_3\\ HO.\end{matrix}\right.$$

If this be represented upon the water type, it is formed from two molecules of water—

$$\begin{matrix}H\\ H\end{matrix}O$$
$$\begin{matrix}H\\ H\end{matrix}O$$

two atoms of hydrogen, one from each molecule being replaced by the biatomic atom lead, whilst one of the remaining atoms of hydrogen is replaced by NO_2, thus—

$$\begin{matrix}NO_2 & \\ & O\\ Pb & \\ & O\\ H & \end{matrix}$$

But if the binary theory be adopted, it must be represented as lead combined with the radical NO_3, and also with the radical HO, and the biatomic lead holds thus two atoms together, just as much as biatomic oxygen holds together ethyle and hydrogen in alcohol. If we mix our lead compound with sulphate of silver, and heat with water, we replace the one atom of lead in it by two atoms of silver, getting a mixture of nitrate of silver and brown hydrated oxide of silver, just as the replacement of oxygen in alcohol by Cl_2 forms chloride of ethyle + hydrochloric acid.

We are thus led to consider these metals as biatomic, and to represent their oxides by the old formulæ CaO, BaO, PbO, whilst carbonates, sulphides, and sulphates have formulæ like $CaCO_3$, $CaSO_3$, $CaSO_4$, their chlorides, nitrates, and phosphates have formulæ like $CaCl_2$, $Ca(NO_3)_2$, $Ca_3(PO_4)_2$. Nitrate of potash has thus a similar formula (NO_3K) to arragonite CO_3Ca, and their isomorphism is no longer surprising. The same remark applies to calc spar and nitrate of soda.

Another analogous group of metals is the triad, magnesium, zinc, and cadmium, all volatile and forming salts which greatly resemble one another, and in many cases isomorphous. The constitution and properties of Frankland's zinc ethyle leaves no doubt of the biatomic character of zinc, for the compound $Zn(C_2H_5)_2$ has the same molecular volume as ether $O(C_2H_5)_2$, and if the atom of zinc were taken out and replaced by one atom of oxygen, there would be no change of volume. Then half the ethyle in zinc ethyle is replaceable by iodine, just as half the ethyle in ether is replaceable by potassium.

The biatomic character of this family being thus established, we can extend the conclusion to the other metals which form magnesian oxides, so called from the striking analogy of constitution of several of their salts with the corresponding salt of magnesia. In this manner we are led to adopt for iron, manganese, nickel, cobalt, and copper atomic weights corresponding to biatomic characters. The subsulphide of copper is thus represented by the formula Cu_2S, which is sufficiently similar to that of sulphide of silver, Ag_2S, to remove our surprise at their isomorphism. There is, moreover, in the reactions of alumina, sesquioxide of iron, sesquioxide of chromium, and sesquioxide of manganese, much resemblance. All these are weak bases, and their sulphates form with sulphate of potash those most characteristic salts called alums. The three first are isomorphous in the uncombined state, so that the conclusion established for iron and manganese may be extended to aluminium and chromium. But it is also arrived at by other means, for chromium in combination with oxygen and chlorine forms the well-characterised compound CrO_2Cl_2 chloro-chromic acid, which contains the same quantity of oxygen and of chlorine as chloro-sulphuric acid in two volumes of vapour, having 52·5 of chromium in the place of the 32 of sulphur of that compound. Again, chromic and sulphuric acids exhibit a marked resemblance of properties, the former being, if anything, even more distinctly bibasic than the latter, and their normal potash salts are isomorphous, so that chromium is abundantly proved to be similar to sulphur in atomicity, and brings in evidence of its own in favour of the biatomic character of aluminium, iron, and manganese. In like manner manganese in manganic acid is connected with sulphur in sulphuric acid, and requires a corresponding biatomic weight. The isomorphism and general analogy of permanganate of potash with perchlorate of potash has often been alluded to as pointing to the necessity of representing the former by a formula containing one large atom of manganese, MnO_4K: but although this formula, by assimilating the expressions for these two similar bodies, removes one difficulty, it creates at the same time another difficulty, by presenting a formula containing only one atom from the first family of elements. The speaker said he would not at present hazard any opinion regarding the propriety of removing this difficulty by doubling the above formulæ, together with that of perchlorate of potash, although he might remark that the constitution of the basic per-iodate of soda points to the formula $I_2O_9Na_4\,3\,(H_2O)$.

An exceedingly strong ground for admitting for many heavy metals the atomic weight corresponding to a biatomic character was brought forward some time ago by Wurtz, who pointed out that adopting for oxygen the atomic weight 16, we get a half-molecule of water

$$\frac{H_2O}{2}$$

in one molecule of various salts if we consider the heavy metals monatomic.

Other ,metals are susceptible of reduction by similar analogies to the class of elements which are biatomic or tetratomic, &c. Thus mercury is proved by the ethylide and methylide to be biatomic by the fact that the compound for one atom of mercury with two atoms of ethyle or of methyle, occupies the same volume in the state of vapour as the compound of one atom of oxygen with two of ethyle or of methyle $Hg(CH_3)_2 = 2$ vols., and we can take out one atom of methyle from the bi-methylide of mercury, and replace it by an atom of chlorine, bromine, or iodine without disturbing the type,

$$\begin{matrix}CH_3\\I\end{matrix}\,Hg.$$

The common bi-chloride of mercury has, moreover, a vapour volume corresponding to the biatomic character of the metal, and the same thing holds good of the vapour of metallic mercury itself, which has the same volume as the metal cadmium, and probably zinc, and the well-known biatomic radicals CO, SO_2, C_2H_4, but double the volume of the elements oxygen and sulphur. In the present state of our knowledge the speaker was not aware of any sufficient grounds for deciding which of these two constitutions of the free molecule of a biatomic element or radical is to be considered as normal and which is abnormal. On the one hand, mercury, cadmium, and all known biatomic radicals have a molecule containing one atom, while the molecule of oxygen contains two atoms, and that of sulphur two at high temperatures and six at lower temperatures. Selenium is at high temperatures like sulphur. It has been amply shown by Dr. Odling and others that tin is biatomic and tetratomic in its two chlorides, and its compounds with the organic radicals and chlorine, &c., leave no room for doubt on the point.

By similar chains of evidence the remaining metals can be shown to belong to the great biatomic class containing already so many.

The vapour densities of the so-called sesquichlorides of iron, aluminium, and chromium, as determined by Deville, show that the molecule of each of these bodies contains two atoms of metal and six atoms of chlorine, in fact, the same quantity of metal as the molecule of the sesquioxide: this fact has been held to be an anomaly from the point of view adopted regarding their atomic weights. The speaker believed, however, that so far from being anomalous, these vapour densities are the least which can be reconciled with the conclusion that the metals permanently combine with even numbers of atoms from the first family, for if one atom of iron could on occasion combine with three atoms of chlorine to form one molecule, the law respecting it would assume the not very wise form—that iron combines with an even number of atoms from the first family, except when it combines with an uneven number!

The fact is that the sesquichlorides are not exceptions to the law, as at first sight they are suspected of being. Precisely the same remarks apply to the so-called subchloride of sulphur of which the molecule S_2Cl_2, as re- by the law. So also cyanogen C_2N_2, acetylene C_2H_2, ethyle, C_4H_{10}, &c., &c. Amongst exceptions, the speaker mentioned nitric oxide and calomel, both of which have vapour densities corresponding to the molecular formulæ NO and HgCl.

Many compounds are known to undergo decomposition on evaporation, and to be reproduced on condensation; thus NH_5O yields the two molecules NH_3 and H_2O, each with its own volume, as also SO_3H_2 yields SO_2 and H_2O. SO_1H_2 and PCl_6 are also known to yield on evaporation vapour corresponding to a breaking-up into two molecules; and there are strong reasons from analogy, as well as experimental evidence, to believe such decomposition. As, however, a high authority seems inclined to doubt the decomposition, the matter may be considered as still *sub judice*.

The existence of basic salts of mercury or copper, when apparently monatomic, is another class of apparent exceptions to the law. For if, in the sub-nitrate of mercury, the atom of metal really replaced one atom of hydrogen, just as potassium does in nitrate of potash, there ought not to be basic sub-nitrate of mercury any more than a basic potash salt; whereas, if the sub-nitrate of mercury contains, as the speaker asserted, in one molecule two atoms of metal and two atoms of the salt radical of the nitrates (NO_3), then a basic salt is as natural and intelligible a compound as the basic nitrate of the red oxide.

The action of ammonia on calomel confirms the molecular weight Hg_2Cl_2; for the compound NH_2Hg_1Cl, formed simultaneously with sal ammonia, proves that twice (HgCl) takes place in the reaction.

CANTOR LECTURES.

"*On Chemistry Applied to the Arts.*" *By Dr.* F. Crace Calvert, *F.R.S., F.C.S.*

Lecture IV.

Delivered on Thursday Evening, April 21, 1864.

Animal Fatty Matters, the various processes for liberating them from the tissues in which they are contained. Their composition and conversion into soap. Composite candles. The refining of lard. *Cod-liver, sperm,* and other oils. *Spermaceti* and *wax*.

It will be quite out of the question for me to enter upon a general description of the properties and composition of fatty matters, as to do so would be to undertake far too wide a field of research. All that I can attempt in this lecture is to give an idea of their composition, and to describe some of their most recent applications to arts and manufactures.

The question of the source of the fatty matters in herbiverous animals has been the subject of a great number of scientific researches, but those of Baron Liebig, Dumas, Boussingault, Payen, and Milne Edwards have left no doubt that when the food of an animal contains a sufficient amount of fatty matter, this is simply extracted from the food, and stored or consumed according to the animal's habits, that is to say, its consumption is in ratio to the activity of the animal; thus, an animal in a state of great activity is comparatively thin, but when confined in a pen or stall it quickly fattens. These gentlemen also proved that when the food is deficient in fatty matters a portion of the amylaceous or saccharine matter becomes converted into fatty matter. The most decisive experiments on this head were made by Mr. Milne Edwards, who found that when bees were confined under a glass shade, with no food but honey, they converted the greater portion of it into wax. Notwithstanding these proofs, however, chemists found it difficult to understand how substances so rich in oxygen as amylaceous ones become converted into a class of matters containing so little of that element, but Baron Liebig has recently published a paper which has partially solved this problem, showing that animals give off during respiration a larger amount of oxygen than is contained in the air inspired, which excess must be derived from certain organic substances circulating in the blood. Fatty matters may be classed under two heads, viz., vegetable and animal. The first are generally composed of a solid, called margarine, and a liquid, called oleine. The latter generally contains three substances, viz., two solids, stearine and margarine, and one liquid, oleine. I say generally, because there are exceptions; thus, in palm oil palmetine is found, in linseed oil linoleine, in sperm oil spermaceti, and in waxes several peculiar acids. Let us now examine the composition of some of the most abundant fatty matters found in animals. The knowlodge of the composition of these substances, of suet for example, was most unsatisfactory until 1811, when my learned and eminent master, M. Chevreul, published his elaborate researches, by which he demonstrated the real composition of fatty matters in general, and that they might be considered as real organic salts. Thus suet is composed of stearic, margaric, and oleic acids combined with the oxide of glyceryle. The three above-named acids he showed to be composed as follows:—

	Stearic acid.	Margaric acid.	Oleic acid.
Carbon . .	68	34	36
Hydrogen . .	66	33	33
Oxygen . .	5	3	3
Water . .	2	1	1

also that oxide of glyceryle, as it is liberated from the fatty acids, combines with water and forms glycerine. He further showed that when fatty matters were saponified, the change consisted in the substitution, for the oxide of glycerile, of the oxide of sodium or soda in ordinary hard soaps, of the oxide of potassium and potash in soft soaps, of oxide of lime, baryta, or lead in insoluble soaps. You will easily conceive the pride of M. Chevreul when, forty years later, M. Berthelot effected the synthesis of the fatty matters, the analysis of which M. Chevreul had published in 1811. This he accomplished by heating in sealed tubes, at a temperature of 520° for several hours, one, two, or three equivalents of each of the above acids with one equivalent of glycerine, leaving the mixture to cool, and then boiling it in a vessel with water and lime, when the excess of fatty acids not combined during the experiment were removed by the lime, leaving the neutral fatty matter, which was dissolved by ether, and thus obtained in a state of purity. By this interesting series of researches, M. Berthelot has not only reconstituted neutral fatty matters, but showed that the oxide of glyceryle was triatomic, that is, that one equivalent of the oxide would neutralise three equivalents of the acid, whilst it required three equivalents of soda to produce a neutral stearate with three equivalents of stearic acid.

Stearic acid, $3\,(C_{68}H_{66}O_5)$, Glycerine, $C_6H_8O_6 - 4\,HO$
Stearic acid, $3\,(C_{68}H_{66}O_5) + 3$ Soda $NaO - 3\,HO$

In fact, the researches of this eminent chemist on the synthesis of organic substances have effected a complete revolution in the last few years in that branch of organic chemistry.

I shall now proceed to give you a rapid outline of the properties of these substances.

Stearic acid is a white crystalline substance, fusible at 158° F., soluble in alcohol and ether, insoluble in water, and saponified by alkalies.

Margaric acid is a solid crystalline substance, presenting the same properties as stearic, excepting that its fusing point is 140°.

Oleic acid is a fluid remaining in that state even at several degrees below the freezing point of water, and is also soluble in alcohol and ether, but not in water.

Glycerine, or the sweet principle of oils, was discovered in 1779, by Scheele, who extracted it in boiling oil of sweet almonds with oxide of lead, which, combining with the fatty acids, liberated the oxide of glyceryle, and this, in combining with water, formed glycerine. In consequence of the numerous applications of glycerine in medicine, the French have manufactured this substance on a large scale from the liquors in which they have saponified their fatty matters into soap; but the purest and most extensive supply is furnished by Price's Patent Candle Company. In the course of this lecture I will give you a description of its preparation as carried out at their works. Glycerine is a colourless, syrupy fluid, of sweet taste, and sp. gr. 1·28, highly soluble in water and alcohol, combining easily with hydrochloric, hydrobromic, benzoic, tartaric, &c., acids, forming neutral compounds. Diluted nitric acid converts it into glyceric acid; concentrated nitric acid into nitro-glycerine, or a substance exploding with violence by percussion, which has caused it to be proposed as a substitute for fulminating mercury, by its discoverer, Professor Sobrero. The application in medicine of glycerine has been greatly extended by its highly hygrometric properties. Thus, bandages moistened with glycerine remain constantly moist, because the glycerine attracts moisture from the air as fast as it is lost by evaporation. It has also been found eminently useful in diseases of the eye and ear. Glycerine boils at 527°, but when distilled is partly decomposed into a peculiar oily fluid, of a noxious odour, called acroleine. M. Berthelot has succeeded, by fermentation, in converting glycerine into alcohol. Again, Mr. George Wilson, F.R.S., the talented director of Price's Patent Candle Company, has applied glycerine with great success to the preservation of vegetable and animal substances. Another useful employment of glycerine is its substitution for water in gasometers, where the evaporation of the latter is a source of serious loss. Its addition to a soap solution increases the facility of forming soap bubbles to an extraordinary degree. In fact, by its aid, bubbles of seven or eight inches diameter can be produced, exhibiting most beautiful purple and green colours, the beauty of which is greatly enhanced, as Mr. Ladd will show you, when illuminated by the electric light. To prepare this peculiar soap solution, the following proportions are stated to be employed:—Distilled water, 5 ounces; soap, $\frac{1}{5}$ of a drachm; glycerine, 2 drachms.

The extraction of the fatty matters of animals from the tissues enveloping them is a simple operation. The old process of doing this, technically called "rendering," consisted in introducing the suet into large iron pans and applying heat, which caused the fatty matters, by their expansion, to burst the cells confining them, and to rise to the top of the contents of the boiler, which were left to stand for a few hours, and the liquid fat was then run off. The organic tissues remaining with a certain amount of fat at the bottom of the boilers were removed and subjected to pressure so as to separate the rest of the fat, the organic tissues remaining behind being sold under the name of scraps for feeding dogs, &c. As this operation gives rise to noxious vapours, causing thereby great annoyance, other methods have been generally adopted. For instance Mr. D'Arcet's, the leading feature of which is to place in a boiler say 350 lbs. of suet with 150 of water and fifteen of sulphuric acid, carrying the whole to the boil for some hours, when the sulphuric acid dissolves the organic matters and liberates the fatty ones, which are then easily separated from the aqueous fluid. Mr. Evrard's process appears preferable. He boils the fatty matters with a weak solution of alkali; or, in other words, he uses 300 lbs. of suet with half a-pound of caustic soda dissolved in twenty gallons of water, carrying the whole to the boil by means of a jet of steam. Under the influence of the alkali the tissues are swollen and dissolved and the fat liberated. By these operations a better quality of fat is obtained and no nuisance is created. It is found advantageous to purify or bleach the above fatty matters by the following means. Mr. Dawson's process consists in passing air through the melted tallow, and Mr. Watson's in heating melted fatty matter with permanganate of potash. Both these processes, as you will perceive, are based on the oxidation of the colouring organic matter. Some tallow-melters further clarify their tallow by adding 5 lbs. of alum in powder to 100 lbs. of melted tallow, which separates and precipitates any colouring matter. The white snowy appearance of American lard, which is rather deceptive to the eye than profitable, is obtained by thoroughly mixing, by means of machinery, starch in a state of jelly with a little alum and lime, with the fatty matter, by which means two ends are attained—viz., the introduction of 25 per cent. of useless matter, and a perfect whiteness from the high state of division of the same. The fatty matters from fish are generally obtained by boiling those parts of the fish containing them with water, when the fatty matters rise to the surface af the fluid, and one whale has been known to yield as much as 100 tons of oil. According to M. Chevreul, the composition of whale oil is as follows:—

Solid fats . .	Margarine, Cetine,
Liquid fats . .	Oleine, Phocénine,

together with a small amount of colouring-matter, and of phocenic acid, which gives to whale oil its disagreeable colour and odour. Many attempts have been made to sweeten whale oil by the use of weak caustic lye, milk of lime, sulphuric acid, and steam; but although a great improvement has been effected, the oil is still recognisable by its unpleasant odour. I have no doubt in my mind, from experiments made by my friend, Mr. Clift, that fish oils might be obtained as sweet as vegetable oils, if proper means for their extraction were adopted. Allow me here to revert to animal fats, to show you that their comparative hardness or solidity, as shown by the following table, depends upon their relative proportions of stearine and margarine, or oleine:—

	Stearine or Margarine.	Oleine.	Melting point.
Ox tallow	75	25	111·0°
Mutton suet	74	26	109·0
Hog's lard	38	62	80·5
Butter (summer)	40	60	86·2
Do. (winter)	63	57	79·7
Goose fat	32	68	79·0
Duck fat	28	72	77·0

M. Pelouze proved some years ago that the rancidity of ordinary animal as well as vegetable oils is due to a fermentation; that is to say, that under the influence of the azotised principle associated with all fats, the fatty matters split into their respective fatty acids and glycerine, which in their turn undergo a further change, resulting in the production of volatile fatty acids, such, for example, in the case of butter, as butyric, caproic, capric, and caprolic acids; in the case of goat's milk, hircic acid; of fish oil, phocenic acid. Further, M. Pelouze demonstrated that in the case of olive oil this change occurred a few hours after the crushing of the berries, the oil thereby coming in contact with the albuminous principles or ferment.

I shall now have the pleasure of calling your attention to some of the special applications which fatty matters receive. The first of these arises out of the action of alkalies upon these substances, the result of which is the conversion of an insoluble matter (oil) into a soluble one (soap). I shall not enter into minute details of this well-known manufacture, but content myself with touching upon some of the most recent improvements. The usual mode of making soap is to add animal fats or vegetable oils to a weak lye, or caustic solution, carrying the mixture to the boil by means of steam-pipes passing through the vessel above a false bottom, and keeping the whole in constant agitation by means of machinery. During this operation the oxide of sodium replaces in the fatty matter the oxide of glyceryle, and when the lye is killed, that is to say when all its alkali is removed by the oil, a fresh or stronger lye is added, and these operations are repeated until the manufacturer considers that the matter is nearly saponified, which is easily judged of in practice. He then proceeds with a second series of operations, called salting, which have for their object to separate the glycerine and impurities from the soapy mass, and also to render the latter more firm and compact, in fact, to contract it. This is effected by treating it with stronger lye mixed with a certain quantity of common salt, and allowing it to stand for a few hours, so that the mass of soap may separate from the fluid containing glycerine and other impurities. When the second series of operations are finished the clarifying or finishing process follows: this requires the use of still stronger lye and salt, which not only complete the saponification, but separate any remaining impurities; the semifluid mass of soap is then allowed to stand for twelve hours, when the soap is either run or ladled into large wooden moulds, and allowed to stand until quite cold. After standing for a day or so, the wooden frame is removed from the solid mass of soap, when it is divided into bars by means of a brass wire. The difference between *white curd* and *mottled* soap is caused by the addition to the fluid mass of soap of about four ounces of alum and green copperas to every 100 lbs. of soap, which gives rise to an alumina and ferruginous soap, which, on being diffused through the mass by means of agitation, mottles or marbles the mass when cool. When well prepared this is the most economical soap, as no large quantity of water can be introduced to weight it, because this would cause the separation of the mottling material from the soap. *Fancy soaps* are prepared in the above manner by the employment of a better quality of materials and the addition of various perfumes. *Rosin or yellow soap*, as its name implies, is one in which a portion of the fatty matters is replaced by rosin, which is added to the soap paste when there is but little aqueous solution of alkali left to dissolve it, so that the rosin can at once enter into the composition of the soap, instead of being dissolved in the alkaline lye and lost. Rosin soaps, nearly white, are now manufactured, owing to the discovery of Messrs. Hunt and Pochin, who have succeeded in obtaining nearly white rosins by distilling common rosin with the aid of superheated steam. *Silicated soaps* are much used in America, owing to their cheapness, which is due to the introduction of a certain amount of silicate of soda. *Transparent soap*, the method of making which was so long kept secret, is now known to be obtained by dissolving soap in alcohol and allowing a concentrated solution of it to cool slowly, when it is poured into moulds and allowed to solidify. One of the most useful and recent improvements in soap-making is that which enables the manufacturer to produce what is called *glycerine soap*, which is characterised by the retention of the glycerine of the fatty matter. Its manufacture only occupies a few hours, instead of several days, as is the case with ordinary soap. It is prepared by employing 63 parts of fatty matter, 33 of water, and 5 of alkali, which are heated to a temperature of between 350° and 400°, for two or three hours, when the mass is entirely saponified, and then has only to run into moulds to be ready for the market. But the most important discovery connected with the saponification of fatty matters by means of alkali is that recently made by M. Mèges Mouries, for this gentleman has arrived at the remarkable result of saponifying fatty matter in the space of twelve hours, and, what is more extraordinary still, at natural temperatures. If we connect this fact with the one that caustic soda is now manufactured by tons, it appears highly probable that in a few years the fatty matters of Brazil and Monte Video, instead of being sent to this country as such, will be converted into soap there, and imported thence by us in that form. M. Mouries has discovered the fact that fatty matters are susceptible, under peculiar circumstances, of being brought into a globular state, and that when in that state they present new and peculiar properties. Thus, for example, fatty matters, when kept in a damp state, usually become rapidly rancid, whilst when in the globular state they may be kept for a very long period without undergoing that change. This peculiar state can be imparted to fatty matters by melting them at 130° and adding a small quantity of yolk of egg, bile, albuminous substances, or, what is best, a solution of alkali, composed of five to ten parts of alkali for every 100 parts of oil, at the same temperature, agitating the whole for some time to bring the fatty matter into a globular condition. If at this stage the action of the alkali is continued and the temperature is raised to 140°, it is found that instead of the fatty matters requiring a long time to saponify (as is usual even at a temperature of 212°) the saponification is most rapid, because each globule of fatty matter offers an immense surface to the action of the alkali; and it is found that in two or three hours the whole of the fatty matters are converted into soap. In fact, saponification is so perfect that tho mass of soap dissolves completely in water; and if the purpose is to liberate the fatty acids, this can be done at once by the addition of a little vitriol. The fatty acids produced by this comparatively cold saponification are so pure that, when subjected to pressure, the solid fatty acids have not the slightest odour, and fuse at the point of 138°. As to the oleic acid prepared by this process, instead of being brown (as is usual with the commercial acid), it is colourless, and can be employed in manufacturing soap of good quality. When M. Mouries desires to make soap with the entire fatty matter, he acts at once upon the globular fatty mass by adding salt, which separates the soap from the aqueous fluid; it is then melted and run into moulds. Whilst speaking of the mode in which alkalies can be made to act upon fatty matters, I ought to state that M. Pelouze observed the curious fact that large quantities of fatty matters could be split into their respective elements, viz., fatty acids and glycerine, by heating them for some hours with a small quantity of soap. This discovery, as we shall presently see, has been taken advantage of in the manufacture of stearic candles.

Permit me to state that *soft soaps* differ from hard soaps mainly in the substitution of potash for soda, and in the omission of the salting and clarifying processes, so that the soapy mass is not separated from the excess of water, and therefore after the fatty matter has been saponified by the alkali, tho whole is evaporated to the required consistency. I cannot conclude better this hasty and imperfect sketch of the soap manufacture than by the following table of compositions, showing the percentages of the various elements in the following soaps:—

Names of soaps.	Fatty acids.	Alkali.	Water.
Curd . . .	62	6·0	32·0
Marseilles . .	60	6·0	34·0
White . . .	60	6·4	33·6
White cocoa . .	22	4·5	73·5
Yellow rosin . .	70	6·5	23·5
Calico printers .	60	5·2	34·8
Silk boiling . . .	57	7·0	36·0
Wool scouring .	55	9·0	36·0
Soft . . .	43	10·0	47·0
Theoretical . .	63	6·4	30·6

As it is easy to introduce into soaps a much larger quantity of water than they should contain to render their employment economical, it behoves those who use large quantities in their manufacture to ascertain the extent of the moisture contained in soaps. This may be pretty accurately approximated to by placing a quarter of an ounce, divided into thin shreds, upon a hob or other warm situation, and leaving it for several days, when it will lose nearly the whole of the water it originally contained, or about a third of its weight if it does not contain an undue proportion. In many instances the proportions of alkali in soap may seriously affect its applicability. Thus, I ascertained a few years since that the quality of soap best adapted to clear madder purples should not contain more than 5 per cent. of alkali, whilst for pinks, where it is necessary to remove any loose colour which the mordants may have mechanically retained, a more active soap is required—viz., one containing from 6 to 7 per cent. of alkali.

(To be continued.)

LECTURES ON CHEMICAL PHILOSOPHY.—II.

Delivered at the College of France, by M. A. WURTZ.

BODIES combine in definite proportions: this is a fundamental law in chemistry. It governs all the questions which agitate the science, and lies at the bottom of all the problems it seeks to solve.

The idea of atoms is the theoretical expression of this law: the notion of equivalents flows directly from it. It is important, then, at starting to establish the precise meaning of the words *atom, équivalent, molécule;* and to see how these notions, at first ill-defined, and often confounded one with another, have gradually assumed the precise sense we attribute to them to-day.

The notion of equivalents was introduced to science by the remarkable labours of two German chemists—Wenzel and Richter. Setting aside the researches of Wenzel, which are well known, we shall only call attention to some of the numerical results obtained by Richter, from which we may derive some instructive lessons.

Richter, like Wenzel, recognised the proportionality of the quantities of bases which saturate equal weights of different acids, and reciprocally the quantities of different acids which saturate equal weights of different bases. He was led to construct two sorts of series.

The first expressed the quantities of bases which saturate 1000 parts of sulphuric acid, 1000 parts of nitric acid, &c.; the second gave the quantities of acid saturating 1000 parts of potash, lime, alumina, &c.

Although Richter's deductions rest upon less exact analyses than those of Wenzel, he confirmed and generalised upon the law of proportionality propounded by his predecessor. One thing, however, escaped him; he failed to see the inutility of multiplying the series, and that to establish the law it was only necessary to take one, choosing as the term of comparison 1000 parts of an acid or a base—1000 parts of sulphuric acid, for example. This fact, however, was perceived by Fischer, who calculated from Richter's experiments the following series of the *equivalent* quantities of acid and of bases necessary to saturate reciprocally and form neutral salts:—

Bases.	Fischer's numbers.	Exact numbers.	Acids.	Fischer's numbers.	Exact numbers.
Alumina .	525	428	Sulphuric .	1000	1000
Magnesia .	615	200	Hydrofluoric	427	500
Ammonia .	672	—	Carbonic .	577	550
Lime . .	793	700	Hydrochloric	712	912
Soda . .	859	775	Oxalic . .	755	900
Potash . .	1605	1177	Phosphoric .	979	887
Baryta . .	2222	1912	Formic . .	988	925
			Nitric . .	1405	1350
			Acetic . .	1480	1275

If we represent 1000 parts of sulphuric anhydride by SO_3, KO will figure as 1605 parts of potash, BaO as 2222 parts of baryta, and the compounds of each of these bases with SO_3, may be written SO_3KO, SO_3BaO.

If we represent 1000 parts of sulphuric acid by SO_3, the quantity of alumina which combines with it will be represented by the formula alO, in which O represents an amount of oxygen equal to that contained in KO.

The formulæ alO and KO, SO_3alO and SO_3KO, represent their equivalent quantities, according to Richter and Fischer. We usually, however, represent sulphate of alumina by $3SO_3, Al_2O_3$. We multiply the equivalent of each body by 3. Here is an anomaly—an inconsistency introduced into the equivalent notation—an infringement even of the principle of this notation. The real equivalent of alumina is the amount of this oxide which will saturate SO_3; but this quantity, which we represent by alO, is only equal to one-third of the quantity indicated by Al_2O_3. The true equivalent formula of sulphate of alumina is then in this respect SO_3alO. Richter was not mistaken. A similar remark applies to the equivalent which he has given for phosphoric acid. The true equivalent of this acid is the quantity which saturates an equivalent of oxide RO; that is to say, one-third of PO_5, and not PO_5 which saturates 3RO. In fact, the quantity of phosphoric acid which saturates 3 molecules of oxide of silver cannot be equivalent to the quantity of acetic acid which saturates 1 molecule of oxide of silver.

Let us pass now to the equivalents of the simple bodies, taking, for example, 35·5 of chlorine.

35·5 of chlorine	combine with	1 of hydrogen	to form	ClH
,,	,,	8 of oxygen	,,	ClO
,,	,,	39 of potassium	,,	ClK
,,	,,	23 of sodium	,,	ClNa
,,	,,	9⅓ of alumina	,,	Clal
,,	,,	28 of iron in ferrous chloride	,,	ClFe
,,	,,	18⅔ of iron in ferri chloride	,,	Clfe

All the numbers 1, 8, 39, 23, 9⅓, 28, 18⅔ are equivalents in relation to chlorine. Iron combining with chlorine in 2 proportions we represent the two equivalents by Fe and fe. Instead of formulating the perchloride of iron and of alumina by Al_2Cl_3 and Fe_2Cl_3, which is not correct, we express them by Clal and Clfe.

The formulæ Al_2Cl_3 and Fe_2Cl_3 are not equivalent formulæ; they represent *molecules*, and are founded upon the atomic notation. Al_2, for example, represents 2 atoms of aluminium, Cl_3 3 atoms of chlorine, and Al_2Cl_3 represents the smallest amount of that body which can exist free.

The atomic theory we owe to the labours of Gay-Lussac. Dalton was the author of the atomic *hypothesis*. He supposed that the definite proportions, and the multiple proportions, in which bodies combine with each other, represent the relative weights of atoms, small masses indivisible by chemical force, of a fixed value for every sort of matter, and which are joined together in compounds. When a body, A, combines in several proportions with another body, B, it is several atoms of A which are joined to a single atom of B.

This idea of atoms, revived from Leucippus and Epicurus, is merely an hypothesis—a theoretical conception, which does not admit of experimental demonstration. We may remark, further, that the atomic weights of Dalton only represent the proportions in which bodies combine with and replace each other in compounds—that is to say, equivalents. The true atomic theory originated from the experiments of Gay-Lussac on the volumetric relations, according to which gases combine with each other.

We know that 1 gr. of hydrogen unites with 8 grs. of oxygen to form 9 grs. of water, and that two volumes of hydrogen unite with one volume of oxygen to form two volumes of the vapour of water. If we represent 1 gr. of hydrogen by H, and 8 grs. of oxygen by O, the formula HO will represent the proportions by weight in which the two bodies are combined in 9 grs. of water; the formula HO, then, is the equivalent formula of water. This is the formula of Dalton.

The atomic theory, on the contrary, supposes that the *volumetric proportions* 2 and 1, according to which oxygen and hydrogen combine, represent the *atomic proportions*, that is to say, the relations between the number of atoms. The *volumes* represent the *atoms*, and thus the relative weights of the volumes of gas, or their *densities*, represent the *atomic weights*.

Berzelius adopted these ideas, and constructed upon them a new system of formulæ. If two volumes of H combine with one of O, it is two atoms of H, which combine with one of O, and consequently the formula of water, he said, ought to be H_2O. Attributing to oxygen the atomic weight 100, he was led to represent the atomic weight of hydrogen as 6·24. Analogous considerations served him to fix the atomic weights of several other gaseous bodies. Chemical analogies, as well as the data relative to the specific heat and isomorphism, served as the basis of the determination of the atomic weights of other bodies. With four exceptions we still employ the atomic weights as determined by Berzelius; in the cases of lithium, sodium, potassium, and silver, we halve the numbers of Berzelius. Why? The study of some important physical laws will show us the reason.

(To be continued.)

ACADEMY OF SCIENCES.

July 18.

M. **Ch. Sainte-Claire Deville** forwarded some reflections *à propos* to the memoirs of M. Debray on the dimorphism of arsenious and antimonious acids.

M. H. Sainte-Claire Deville contributed a note "*On the Passage of Gas through Homogeneous Solid Bodies.*" The author has continued his experiments on the passage of hydrogen through the walls of wrought iron tubes. His method is well known to our readers. A wrought-iron tube filled with nitrogen is placed in a porcelain tube, through which a current of hydrogen is passed. Upon observing the pressure on the inside and on the outside of the iron tube, it is found that that of the interior may become almost double that of the exterior, in consequence of the hydrogen permeating the walls of iron, and adding its pressure to that of the nitrogen. Unless the temperature is very high no nitrogen passes out, but at very exalted temperatures the author remarked that the internal and external pressures became equalised in consequence of the inter-molecular spaces becoming so much dilated as to allow the nitrogen to pass freely. M. Deville conceives that if we knew the law of the dilatation of these inter-molecular spaces we might determine the relative size of the molecules of hydrogen and nitrogen.

When the pressure in the interior of the tube has reached its maximum, the author analyses the mixture of gases and calculates the pressure of each, and finds that at very high temperatures the pressure of hydrogen within is very much greater than without. We give one example:—

External pressure of hydrogen.	Internal pressure of mixture.	Percentage of H. in mixture.	Calculated pressure of hydrogen.
760 mm.	1851 mm.	64·8	1200

This result is at variance with all the known facts relating to the diffusion of gases, and can only be explained either on the supposition that in the interior of the tube the mixture acts like homogenous matter—an explanation difficult to admit in the present state of science, or by supposing that the result depends upon the fact that in the interior the gases are motionless, while on the exterior the hydrogen is in movement. If this latter explanation be the correct one, the author says he may draw from the facts important consequences in support of the mechanical theory of heat, and some new ideas on the constitution of gases and Graham's hypothesis. He intends, however, first to attentively consider the conditions of the experiment, some of which may have escaped him.

So much attention was excited by his first discovery, that we may announce that M. Boucher de Perthes has been digging again at Moulin-Quignon, and has turned up another jaw and a skull.

The aërolite which fell at Orgueil still attracts the attention of French chemists, and M. Pisani has made an analysis, and proved the presence of soluble hyposulphites.

M. F. Margueritte communicated a note "*On the Carburation of Iron by Contact on Cementation.*" The object of the note is to show that iron is converted into steel by contact with carbon without the intervention of nitrogen. The author experimented with diamonds (instead of charcoal) in an atmosphere of chemically-pure hydrogen, and in vessels absolutely impermeable to the gases from the furnace.

MM. Riche and Bérard presented a note "*On the Bromated Compounds of Benzol and its Homologues.*" The authors have formed bromated compounds of benzol, xylol, cumol, and cymol. With regard to the last, they remark that cymol made from camphor does not appear to form the same derivatives as that from oil of cumin.

NOTICES OF BOOKS.

A Dictionary of Chemistry, and the Allied Branches of other Sciences, &c. By Henry Watts, B.A. London: Longman and Co. 1864. Parts xvi. and xvii.

This valuable work continues to be regularly issued, and we need hardly say that the articles are kept up to the standard of excellence which distinguishes this dictionary from all of the kind which have preceded it. The two numbers we now notice contain articles on hydrogen, indigo, iodine, and the commencement of one of great interest on iron.

Journal für Praktische Chemie. Edited by O. L. Erdmann and G. Werther. Nos. 10, 11, 12.

The first of these numbers contains a long article by Dr. J. Websky on the formation and composition of peat, the interest of which is not in proportion to the length.

Dr. Spirgatis gives an account of a resin obtained from the root of *Ipomœa turpethum*. It appears to be a drastic purgative, and, like Convolvulin and Jalapin, to be a glucoside. The composition, moreover, according to Dr. Spirgatis, is the same as that of the two bodies just named. The author has given the name *turpethin* to the resin. When boiled with dilute sulphuric acid it splits up into sugar and an acid body, to which the author has given the name *turpetholic acid*.

Dr. Buchner publishes a *Contribution to the History of Berberin*, correcting Mr. Dyson Perrins on a few unimportant matters.

The same author describes an *Ethereal Oil obtained from the Fruit of the Pinus Reginæ Amaliæ.* This oil is closely allied to turpentine, but possesses some peculiar properties. It ozonises air much more strongly than oil of turpentine, and dissolves iodine freely without decomposing. It forms also a stable compound with hydrochloric acid. As a remedy it may be used wherever the employment of turpentine is indicated, and, indeed, it is to be preferred on account of its more agreeable smell.

R. Hermann contributes some *Researches on Cerium;* they are confined to the oxides and the red and yellow sulphates.

H. Werther continues his *Contributions to the Knowledge of Thallium.* The author describes the hyposulphite of soda and thallium, silicofluoride of thallium, double sulphates of nickel, zinc, iron, and magnesia, and thallium, and appends analyses of all these compounds. He also gives some determinations of the solubility of iodide of thallium in water and spirit, the former differing somewhat from our own results. We shall return to this paper on a future occasion.

The same author gives an account of the formation of dithionic or hyposulphuric acid in a hitherto unobserved way. It seems that when selenium is treated with an alkaline sulphite a selenide of the alkali and a hyposulphate are formed, *e.g.*—

$$2NaOSO_2 + Se = NaSe + NaO,S_2O_5.$$

Number 11 opens with a series of papers by Schönbein, of which we now give only the titles, most of them deserving a full abstract on a future occasion. The first is entitled, Some Views on Hydrosulphurous Acid; 2. On a new and highly-sensitive Reagent for Peroxide of Hydrogen and Nitrites; 3. A Contribution towards a more intimate knowledge of Human Urine; 4. On the Formation of a Fluorescent Material by the Decomposition of Human Urine; 5. On the Occurrence of Peroxide of Hydrogen in the Human Body. It will be seen that all these papers are of great interest.

A paper, by Dr. Herman Grothe, "On the Behaviour of Solutions of Metallic Oxides towards Alkalies in the Presence of some Non-volatile Organic Bodies," shows that many metallic oxides are not precipitated by alkalies when tartaric or citric acid or sugar is present in the solution. This fact is not unknown to our readers, but the author has extended his experiments to some which we believe have not before been noticed in this relationship.

Dr. Bothe gives a simple method of *silvering glass in the cold way*, which we shall give at length in an early number.

Gustav Reichert describes a double salt of nitrate with chloride of silver—$AgONO_5 + AgCl$.

The remaining papers are translations of articles which have already appeared in abstract or at length in the Chemical News.

CORRESPONDENCE.

Continental Science.

Paris, July 28, 1864.

The good and learned Abbé Moigno deserves the thanks of his numerous friends in this city for having introduced an innovation at his last lecture on the Progress of Science during the month, in the hall of the Societé d'Encouragement, which cannot fail to be adopted, in hot weather at least, by all *entrepreneurs* of public meetings or entertainments. Instead of being illuminated by the innumerable jets of gas with which the hall is provided, a single electric light, placed in a central position, lit the room in the most perfect manner. The consequence was that, although the thermometer was above 100° out of doors, no one was inconvenienced by the heat, and although there were nearly 500 persons present, hardly a single pocket handkerchief was used as a *sudarium* during the meeting. While enjoying the comparative coolness, one could not help thinking of the summer evening meetings of the London Chemical Society, held in the hottest and worst ventilated meeting-room it was ever my ill luck to enter.

The heat here during the last week has been positively frightful, and forms the only subject of conversation everywhere.

M. E. Kopp announces the discovery of a new chromic salt—the double chromate of potash and ammonia,—which promises, from the facility with which it decomposes under the action of light, to be of the greatest service in photography. The salt is easily made. Strong liquid ammonia is poured on pure bichromate of potash until the whole of the ammonia is neutralised by the second equivalent of chromic acid. A slight excess of the alkali is then added, and the whole is heated and set aside to crystallise under a bell jar, beneath which a few drops of liquid ammonia have been spread. The sensitive surface is prepared in the dark, and is of a light orange colour. Exposure to light turns it to a dark brown. To fix the image it is only necessary to wash the print in some clear water, to which a few drops of hydrochloric acid have been added. M. Kopp regards the image as being composed of the chromate of chromium—*i.e.*, $CrO_2 = Cr_3O_6 = Cr_2O_3,CrO_3$. According to him, therefore, we may change the colour of the print by acting either on the chromic acid or the base. If we choose the former we may use a soluble salt of lead, silver, mercury, bismuth, &c., and afterwards submit the coloured image so formed to the action of sulphuretted hydrogen or a solution of an alkaline sulphide. If we wish to act on the acid which behaves as a mordant to vegetable colouring matters, we may employ solutions of alzarine, purpurine, logwood, Brazil wood, &c. A solution of logwood, and subsequent treatment with chloride of lime, gives a capital effect, almost equal in colour to a gold-toned print.

In the *Journal* of the Belgian Photographic Society M. Von Monckhoven recommends an economical nitrate of silver bath, which, he says, produces results equal to those obtained by using the ordinary proportions of that very expensive salt. He dissolves 16 grammes of *pure* nitrate of soda and 8 grammes of nitrate of silver in 100 grammes of water (about 70 grains of nitrate of soda and 35 grains of nitrate of silver to the ounce). To every four ounces of solution add three drops of nitric acid. If the albumen is disturbed, add two or three more. The paper must be fumigated with ammonia before use in the ordinary manner, taking care not to continue the process too long, or the paper will turn brown. The toning and fixing of the print is performed in the usual manner. M. Von Monckhoven also gives another process, in which oxide of silver is dissolved in nitrate of ammonia, but it so closely resembles that devised by M. Hardwich that it will not be necessary to give it.

In the *Photographischer Archiven*, M. Obernetter recommends a concentrated solution of perchloride of iron as a detergent for silver stains on the hands or clothes. If gallic or pyrogallic acid has been used, it will be necessary to wash the spot afterwards with a few drops of a strong solution of oxalic acid. A weak solution of this salt is also useful for diminishing the intensity of negatives to be copied in the solar camera. Weak negatives may be transformed into strong ones by using first a solution of chloride of iron, and secondly with pyrogallic acid and nitrate of silver.

Relations between Equivalents.

To the Editor of the CHEMICAL NEWS.

SIR,—In your impression of the 2nd inst. a correspondent, under the name of "Studiosus," has called attention to the existence of a law to the effect "that the atomic weights of the elementary bodies are, with few exceptions, either exactly or very nearly multiples of eight."

Now, in a letter "On Relations among the Equivalents," which was signed with my initials, and inserted in the CHEMICAL NEWS of February 7, 1863, I called attention to the numerical differences between the equivalents of certain allied elements, and showed that such differences were generally multiples of eight, as in the following examples:—

Member of a Group having Lowest Equivalent.	One immediately above the Preceding.	Difference. H=1	Difference. O=1
Magnesium 24	Calcium 40	16	1
Oxygen 16	Sulphur 32	16	1
Lithium 7	Sodium 23	16	1
Carbon 12	Silicon 28	16	1
Fluorine 19	Chlorine 35·5	16·5	1·031
Nitrogen 14	Phosphorus 31	17	1·062
Lowest Term of Triad.	Highest term of Triad.		
Lithium 7	Potassium 39	32	2
Magnesium 24	Cadmium 112	88	5·5
Molybdenum 96	Tungsten 184	88	5·5
Phosphorus 31	Antimony 122	91	5·687
Chlorine 35·5	Iodine 127	91·5	5·718
Potassium 39	Cæsium 133	94	5·875
Sulphur 32	Tellurium 129	97	6·062
Calcium 40	Barium 137	97	6·c62

In the last of the above columns the difference is given referred to 16, the equivalent of oxygen, as unity, and it will be seen that, generally speaking, the equivalent of oxygen is the unit of these differences, just as the equivalent of hydrogen, in "Prout's law," is the unit of the atomic weights. Exceptions there are, however, in both cases which render it necessary to take one half or one quarter of the equivalent of oxygen in the one case, and of hydrogen in the other, in order to represent all the numbers obtained as multiples by a whole number of the given standard.

Now, if the law of "Studiosus" had any real existence, the above facts would resolve themselves into particular cases of its application. For if "the atomic weights are multiples of eight," any differences between them must also be divisible by eight.

We have here the symbols and the atomic weights of sixty-one elements, placed in their numerical order, and in the third column is the difference between each atomic weight and the one immediately preceding it:—

H .	1		Ca .	40	1	Ce .	92	2·5	V .	137	0
Li .	7	6	Ti .	50	10	La .	92	0	Ta .	138	1
G .	9	2	Cr .	52·5	2·5	Di .	96	4	W .	184	46
B .	11	2	Mn.	55	2·5	Mo .	96	0	Nb .	195	11
C .	12	1	Fe .	56	1	Ro .	104	8	Au .	196	1
N .	14	2	Co .	58·5	2·5	Ru .	104	0	Pt .	197	1
O .	16	2	Ni .	58·5	0	Pd .	106·5	2·5	Ir .	197	0
Fl .	19	3	Cu .	63·5	5	Ag .	108	1·5	Os .	199	2
Na .	23	4	Y .	64	0·5	Cd .	112	4	Hg .	200	1
Mg .	24	1	Zn .	65	1	Sn .	118	6	Tl .	203	3
Al .	27·5	3·5	As .	75	10	U .	120	2	Pb .	207	4
Si .	28	0·5	Se .	79·5	4·5	Sb .	122	2	Bi .	210	3
P .	31	3	Br .	80	0·5	I .	127	5	Th .	238	28
S .	32	1	Rb .	85	5	Te .	129	2			
Cl .	35·5	3·5	Sr .	87·5	2·5	Cs .	133	4			
K .	39	3·5	Zr .	89·5	2	Ba .	137	4			

Now, it will be observed that in all the above differences the number eight occurs but once, and we never meet with a multiple of eight, whereas if the law of "Studiosus" were true the equivalents of the elements, in whatever order they might be placed, should, when not identically the same, differ either by eight or by some multiple of eight in every case.

While upon the subject of "relations among the equivalents," I may observe that the most important of these may be seen at a glance in the following table:—

			Triad. Lowest term.	Triad. Mean.	Triad. Highest term.	
I.		Li 7	+17 =Mg 24	Zn 65	Cd 112	
II.		B 11				Au 196
III.		C 12	+16 =Si 28		Sn 118	
IV.		N 14	+17 =P 31	As 75	Sb 122	+88 = Bi 210
V.		O 16	+16 =S 32	Se 79·5	Te 129	+70 = Os 199
VI.		F 19	+16·5=Cl 35·5	Br 80	I 127	
VII.	Li 7	+16 = Na 23	+16 =K 39	Rb 85	Cs 133	+70 = Tl 203
VIII.	Li 7	+17 = Mg 24	+16 =Ca 40	Sr 87·5	Ba 137	+70 = Pb 207
IX.			Mo 96	V 137	W 184	
X.			Pd 106·5		Pt 197	

This table is by no means so perfect as it might be; in fact, I have some by me of a more complete character, but as the position to be occupied by the various elements is open to considerable controversy, the above only is given as containing little more than those elementary groups the existence of which is almost universally acknowledged.

I now subjoin a few explanatory remarks on the different groups contained in the above table, the number attached to each group being merely for the purpose of reference.

Group II.—Boron is here classed with gold, both these elements being triatomic, although the latter is sometimes monatomic.

Group III.—Silicon and tin stand to each other as the extremities of a triad. Titanium is usually classed along with them, and occupies a position intermediate between silicon and the central term or mean of the triad, which is at present wanting; thus,

$$\frac{\text{Si } 28 + \text{Sn } 118}{2} = 73, \text{ mean of triad, and}$$

$$\frac{\text{Si } 28 + \text{Mean of triad } 73}{2} = 50\cdot5, \text{ the eq. of Ti being } 50.$$

Group IV.—The equivalent of antimony is nearly the mean of those of phosphorus and bismuth; thus,

$$\frac{31 + 210}{2} = 120\cdot5, \text{ the eq. of Sb being } 122.$$

Group VII.—The relations which M. Dumas has pointed out between the members of this group are well known; a slight alteration must be made, owing to the atomic weight of cæsium having been raised. The relations, then, will be thus:—

$Li + K = 2Na$, or in figures, $7 + 39 = 46$
$Li + 2K = Rb$, ,, ,, $7 + 78 = 85$
$2Li + 3K = Cs$, ,, ,, $14 + 117 = 131$
$Li + 5K = Tl$, ,, ,, $7 + 195 = 202$
$3Li + 5K = 2Ag$, ,, ,, $21 + 195 = 216$

The equivalent of silver is thus connected with those of the alkali metals. It may also, which amounts to the same thing, be viewed as made up of the equivalents of sodium and rubidium, thus, $23 + 85 = 108$. It is likewise nearly the mean between rubidium and cæsium, thus, $\frac{85 + 133}{2} = 109$.

Group VIII.—If lithium may be considered as connected with this group as well as with the foregoing (and by some chemists its oxide is viewed as a connecting link between the alkalies and the alkaline earths), we may perform the same calculations in this group that M. Dumas has done in the preceding, thus,—

$Li + Ca = 2Mg$, or in figures, $7 + 40 = 47$
$Li + 2Ca = Sr$,, ,, $7 + 80 = 87$
$2Li + 3Ca = Ba$,, ,, $14 + 120 = 134$
$Li + 5Ca = Pb$,, ,, $7 + 200 = 207$

Again, there are two triads in the group of alkali metals, one which has been long known—viz., lithium, sodium, and potassium, and the other, which was pointed out by Mr. C. W. Quin, in the Chemical News of November 9, 1861—viz., potassium, rubidium, and cæsium. Potassium is thus the highest term of one triad and the lowest term of another.

In like manner, if we include lithium, we shall have among the metals of the alkaline earths two triads, the first comprising lithium, magnesium, and calcium, and the second calcium, strontium, and barium, calcium standing at the top of one triad and at the bottom of the other.

The element lead occupies a position in relation to the metals of the alkaline earths similar to that filled by thallium in the group of alkali metals. Osmium appears to play a similar part in the sulphur group, and bismuth in the phosphorus group. The analogous term in the chlorine group is not yet known.

Thallium, in its physical properties, bears some resemblance to lead, and it frequently happens that similar terms taken from different groups, such as oxygen and nitrogen, or sulphur and phosphorus, bear more physical resemblance to each other than they do to the members of the groups to which, for chemical reasons, we are compelled to assign them.

It will be observed that the difference between the equivalents of tellurium and osmium, cæsium, and thallium, and barium and lead, respectively, is the same in each case—viz., 70.

Group X.—Palladium and platinum appear to be the extremities of a triad, the mean of which is unknown.

So frequently are relations to be met with among the equivalents of allied elements, that we may almost predict that the next equivalent determined, that of indium, for instance, will be found to bear a simple relation to those of the group to which it will be assigned.

In conclusion, I may mention that the equivalents I have adopted in this latter were taken from the highly-interesting and important paper by Professor Williamson, lately published in the *Journal of the Chemical Society*.

I am, &c.

John A. R. Newlands, F.C.S.

Laboratory, 19, Great St. Helens, E.C., July 12.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Notices to Proceed.

592. Edward Bishop, Headingly, near Leeds, and William Bailey, Halifax, Yorkshire, "Improved means and apparatus for evaporating the water contained in the fœcal or excrementitious matter."

597. John Thomas Way, Leadenhall Street, London, "Improvements in the manufacture of manure from woollen rags, mixed woollen and cotton rags, shoddy, or waste wool."—Petitions recorded March 9, 1864.

639. Thomas Parkinson and Francis Taylor, Blackburn, and Thomas Burton, Padiham, Lancashire, "Improvements in machinery and apparatus for sizing, dressing, dyeing, and drying."—Petition recorded March 14, 1864.

801. James George Beckton, Whitby, Yorkshire, "Improvements in engines or machinery for forcing, blowing, or exhausting the air and other gaseous fluids."—Petition recorded March 31, 1864.

926. Auguste Andigier, Rue Grignan, Marseilles, France, "Embalming and mummyfying dead bodies."—Petitions recorded April 13, 1864.

MISCELLANEOUS.

Trial of Gun-Cotton at Moor Edge Farm.—Mr. Winship's farm, at the Moor Edge, was on Saturday morning last the scena of an interesting trial of the powerful explosive nature of the gun-cotton prepared according to the Austrian process by Messrs. Thomas Prentice and Co., of Stowmarket, Suffolk. The engineering arrangements were conducted by Herr Reve, C.E., assisted by Dr. Richardson, Mr. Hardcastle, of Newcastle, and Mr. Prentice. At the low end of the field, a military stockade, consisting of six heavy piles of the best Memel wood, about 10 feet long, firmly fixed into the ground to about 4 feet, the openings being hacked up with five timbers 9 inches square. In front of the stockade was, in military parlance, a bridge of two timbers 14 inches in diameter, resting on sleepers 1 foot from the ground, on which the explosive shell, of a cylindrical construction, was laid, leaning against the piles. The shell contained 25 lbs. of gun-cotton. About a quarter to one all the preliminaries were completed, when the company, who had been previously engaged in minutely examining the stockade, were requested to go to the top of the field to be out of danger. The "destructable" was then fired by electricity at a distance of 220 yards from a heavy battery placed at this distance from the stockade. Immediately the electric spark reached the machine the explosion occurred; the heavy pieces of timber were soon flying about in all directions, and that which the moment before appeared strong enough to withstand the assault of the enemy was a perfect wreck. Two of the centre piles were literally chopped off to within a foot of the ground; and the other four were removed out of their position to an angle of 170 degrees, one being carried to a distance of 130 yards, leaving a clear space of about 5 feet for the advancing enemy to rush through. The timbers forming the bridge on which the shell was laid were both broken in the middle, and were removed between 30 and 40 yards. The shell itself was broken into atoms, and scattered in all directions.—*Northern Daily Express.*

ANSWERS TO CORRESPONDENTS.

A Reader.—Alcoholate of zinc, $\left.\begin{matrix}2C_2H_5\\Zn\end{matrix}\right\}\Theta_2$, is formed by the slow oxidation of zinc ethyl.

P. H.—We think it has been described in the *Philosophical Transactions.*

P. F. P.—Dry at 112°, and preserve it in well dried and stoppered bottles; there is no other way.

R.—Received with thanks.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Origin of Graphite.—Reports of M. HAIDINGER *and others.*

IRON, after remaining long buried in the earth, at last entirely decomposes, leaving a black, porous, eminently combustible residuum, known as graphite or pure carbon. M. Haidinger's report on the ferruginous masses of Kokitzan and Gotta, near Dresden, masses of uncertain origin, lends support to this general fact.

One word on the formation, still so little known, of graphite (plumbago pencil lead). The presence of graphite in granite, gneiss, and diorite, has renewed the disputes between the Neptunists and Plutonists. Graphite is well known to be nearly pure carbon, for it leaves in burning but a very small quantity of ash. Now, if these primitive crystalline rocks are of igneous formation, it is impossible to explain how graphite could coexist with silicates of protoxide of iron without having reduced these salts. Judging merely by what takes place in blast furnaces, carbon reduces all oxides of iron at a high temperature. It must, then, be admitted that granite, gneiss, and diorite did not contain graphite when the mineral elements of these rocks, such as mica, hornblende, and other ferrous silicates were in a state of fusion. Graphite, then, must have been subsequently introduced into these rocks—but when, and how? Questions such as these are very difficult to answer satisfactorily. The most plausible hypothesis is that graphite has been introduced by the wet way into the crystalline rocks and substituted for one of the mineral components. Thus in the gneiss of Passau (Bavaria) it takes the place of mica.

Graphite is frequently to be met with in granulated limestone—a fact particularly interesting to geologists. Is limestone a product of eruption, or is it a sediment transformed by the action of heat? The presence of graphite is explicable by neither hypothesis. For at a certain temperature, which need not be very high, carbon decomposes carbonate of lime. This salt may, no doubt, under strong pressure, be heated to the melting point without losing its carbonic acid; this is a laboratory experiment often cited by the Plutonists. But it is quite a different thing with a mixture of carbon and carbonate of lime at a high temperature. If we reject the Neptunian origin of granulated limestone, we must then, as with crystalline rocks, suppose that graphite has been introduced by the wet way at a more recent period. The same remark applies to magnetic pyrites (sulphide of iron), often very rich in plumbago kerns.

Does graphite, like all carbon, belong to the organic kingdom? It is certain that anthracite, lignite, coal, are the result of the slow decomposition of an enormous quantity of vegetables; the impressions found on them often indicate the kind of vegetables, most of them extinct, which have contributed to these carbonaceous formations. Graphite, if not formed in precisely the same way as coal and anthracite, nevertheless bears signs of an organic origin. The formation of nuclei and veins of graphite in crystalline rocks is sufficiently explained by the decomposition of carbonised hydrogen gas at a high temperature; this gas, disengaged from organic matters, and penetrating the fissures of the burning rock, would undergo decomposition into hydrogen and carbon.

It is this deposited carbon which forms graphite. If in our laboratories we do not obtain exactly the same product it must be remembered that Nature has means at her command which escape our researches. We find it impossible to make coal from wood. The wood may be carbonised by the dry or by the wet way. In the first case the carbonisation is very rapid; in the latter it is extremely slow, as is shown by the blackened points of piling sunk in water.

Finally, graphite has been found in meteorites or areolites. Attempts have been made to explain its presence here by the continuance of these stones in soil more or less rich in carbonised principles. But with regard to newly-fallen stones this explanation is inadmissible. If it be maintained that graphite is an organic product, it must be admitted that in the case of newly-fallen meteorites it can proceed only from organic matters belonging to another world than our own.

In his report on Alibert graphite M. Dumas presents some considerations on the probable origin of graphite and of the diamond. M. Despretz and others ascribe to fire the change of carbon into diamond; Newton ascribed it to the coagulation of a fatty or oily body; Liebig says the diamond is slowly formed by processes which determine the prolonged putrefaction of a liquid body rich in carbon and in water; then, contrary to M. Despretz's method, a high temperature would be unfavourable to a successful attempt. Adopting Newton's hypothesis, M. Gœppert states, in a "memoir on the solid bodies entering into the composition of the diamond, and considered with regard to their organic or inorganic origin," that he is disposed to class the diamond among the products of the decomposition of organic matters. All these hypotheses M. Dumas rejects; according to him the diamond is crystallised carbon, at the moment of its production and in the midst of a mass which has been exposed merely to the heat necessary to soften it, provided this condition is sufficiently prolonged.

Finally, M. Dumas frankly admits that nothing positive is known as to the true origin of the diamond, though the substance most allied to it, silicium, is perfectly known, and very beautiful crystals of it are obtained.

However, it is positively ascertained that the diamond and graphite have not the same origin, and that the residue of every carboniferous substance, treated at a high temperature, proves to be but a variety of graphite. The new carbon found by M. Alibert in the mines of Marinski, situated at the summit of Batougol, on the Siberian frontiers, is, then, a graphitoid carbon of the most beautiful kind, formed by volcanic phenomena. M. Jaquelain, after carefully comparing the external characteristics of Alibert graphite with that obtained by his process, concludes that the conditions under which they are produced must be analogous.

In fact, on comparing the texture of the two carbons, they will be found sometimes of a metallic, mirror-like lustre; at another time the surface will be of shining steel-grey, mammillated as if it had been half fused, and had passed through a pasty stage. This appearance is similar to that of oxide of iron, nodulous brilliant, with mammillated surface, known by the name of brown hematite.

M. Jaquelain is inclined to admit that tarry and pyrogenated products, transformed in immense proportions into carbon and hydrogen, under the influence of igneous rocks, become accumulated in rents and excavations, causing an aggregation of carbon, and inducing a fusion analogous to that of carbon in retorts for lighting gas, and of graphitoid carbon destined to form the pencils used for the electric light.

On this point M. Jaquelain narrates one of his own recent experiments. On decomposing some sulphide of carbon in a porcelain tube in presence of pure copper, heated to about 800°, sulphite of copper and graphite were formed, externally similar to natural graphite.—*Cosmos*, pp. 720—725, 1864.

PHARMACY, TOXICOLOGY, &c.

On the Active Principles of the Strychnaceæ,[*]
by F. F. Mayer, *New York*.

The literature, medicinal, pharmaceutical, and chemical, of the drugs derived from this family is by no means as extensive as that of opium and of bark, nor is our knowledge of their active principles as accurate as might be expected or desired.

These active principles are supposed to be represented by two or three alkaloids, which, named in the order of discovery, are strychina, brucia, and igasurina. Pelletier and Caventou, in 1818, discovered in the ignatia seed a bitter alkaloid, which they named *Vauqueline*, in honour of the great pharmaceutist; this name Bucher, sen., considered inappropriate, and proposed in place of it *Strychnin*, which it thenceforth retained. *Tetanin* was suggested for it by Magendie. Pelletier and Caventou likewise found this alkaloid in nux vomica and bois de couleuvre, snake wood, lignum colubrinum, from strychnos colubrinum. Shortly after they noticed the existence of a different alkaloid in the bark of *Strychnos nux vomica*, then known as false angustura bark, and supposed to be that of *Brucea antidysenterica*, hence its name of Brucia, in place of which Geiger once proposed caniramin (*canis* dog, *ira* rage). Desuoix, lastly, noticed a crystalline deposit in the alkaline liquor from which strychnia and brucia had been precipitated, and called the same *Igasurina*. Schutzenberger afterwards confirmed that this alkaloid concurred in many properties with brucia, but found it was itself a mixture of no less than nine different bases, varying slightly in the percentage of carbon, hydrogen, and oxygen, and water of crystallisation as well as in solubility. The same chemist had before noticed similar variations in the composition of strychnia. It is readily perceived from the properties ascribed to strychnia especially, and brucia, by Pelletier and Caventou, Pettenkofer, Geiger, and Merck, that these chemists operated with mixtures of the alkaloids. For this reason statements as to the quantity of the respective alkaloids to be found in either nux vomica or ignatia seed, made previous to Wittstock, are not to be relied on. The latter observer states that 10 ozs. of nux vomica yield 12½ grains of strychnia and 31½ of brucia, while, according to Gieseler, 10 ozs. of ignatia seed yield 72 grains of strychnin. Pelletier and Henry obtained between 40 and 50 grains of this impure strychnia from 10 ozs. of nux vomica.

These discrepancies find their explanation in the peculiar character of that portion of the alkaloids which is not readily precipitated by alkalies.

The alkaloid which received the name of strychnia is recorded as scarcely soluble in water and alkalies. Planta, whose observations will in most cases be found at least as trustworthy as those of others who are much more frequently quoted, never uses the expression "insoluble" in such cases, but says "not perceptibly soluble;" and this, as a matter of course, is the case with all alkaloids, since none of them are never completely insoluble in water, or completely precipitated by alkalies proper. Brucia was called originally the precipitate which falls down from mother liquors of crystallisations of strychnia by the addition of more soluble alkali, and igasurine that which finally deposited from the alkaline solution on standing. With the exception of Planta, who mentions the difficulty with which brucia is precipitated by ammonia, I find on record but one instance in which the circumstance is mentioned which enables one, without entering more closely into a consideration of the subject, to give a rapid as well as accurate method for determining strychnia in the presence of the other alkaloids; it is this,—in a paper published by that excellent chemist Dr. F. L. Winchler, of Darmstadt, in 1835, *Repertorium f. de Pharmacie*, Bd. li. p. 369—wherein he mentions the solubility of brucia in ammonia and caustic alkalies and earths, and determines the quantity of brucia in the alkaline mother liquor from the precipitation of strychnia by acidulating, and then precipitating it with corrosive sublimate.

It might be supposed that, as this solubility is considered a characteristic of igasurina solely, this alkaloid or mixture of alkaloids was identical with brucia, and that there were, in fact, but two alkaloids present in the plants of one family. But there is a considerable degree in this solubility; a portion of the dissolved alkaloid crystallises out; while the remainder, which, however, forms a crystalline salt with oxalic acid, is held indefinitely long in solution.

Strychina itself is, to some extent, soluble in alkaline liquids. As the proper alkali for experiments and assays of this kind, I have long since used and recommended in a particular instance crystallised caustic baryta, which, in my opinion, cannot be surpassed by any other substance of this class. My remarks in this connection have, therefore, exclusive reference to precipitation and solution by means of caustic baryta.

100 c.c. of a solution of baryta at 60° F. dissolve 0·036 of a gramme, or 0·55 of a grain of strychnia.

100 c.c. of the same solution of baryta dissolve as a minimum 0·5 gramme, or nearly eight grains of brucia.

In determining the strength of a preparation from a drug containing these alkaloids, it is only necessary to know the quantity of a reagent required for the sum of the alkaloids, to precipitate a known portion of the solution made from the preparation by baryta, and to dilute the alkaline liquor to a certain strength sufficient to hold in solution all the brucia which may be present.

A gramme of pure strychnia requires for precipitation 59·88 c.c. of one-tenth normal solution of iodide of mercury, provided the strength of the solution does not exceed one-half of one per cent. The precipitate produced differs in its composition from that yielded by other alkaloids, inasmuch as it contains two equivalents of mercuric iodide to one of hydriodate of the alkaloid. The quantity of one-tenth normal silver solution equivalent to 59·88 c.c. of mercury solution is 239·52 c.c.; of the eight equivalents of iodine and chlorine contained in the 59·88 c.c. mercurial solution, three of iodine, or three-eighths, are absorbed by the alkaloid, and there is consequently a deficiency of three-eighths of the number of the cubic centimetres of the silver solution—i.e., to precipitate the filtrate from the mercurial precipitate of one gramme of strychnia, only 149·7 c.c. of silver solution are required.

A gramme of pure brucia requires 42·9 c.c. of mercurial solution, and the composition of the precipitate is analogous to that of the strychnia compound, and to that of the combinations of mercuric *chloride* with strychnia and brucia. It is also necessary that the brucia solution be dilute, and contain no more than half per cent., but rather less, of the alkaloid. In this case there consequently will be a deficiency of 64·35 c.c. of silver.

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[*] *Proceedings* of the American Pharmaceutical Association.

Of the troy weight solution of iodide of mercury, containing 16 and two-ninths grains of corrosive sublimate and 69 grains of iodide of potassium in 12½ troy ounces, every 10 grains correspond to 0·0334 of a grain of strychnia, and 0·0466 of a grain of crystallised brucia.

With these data the subjoined assays have been made, exhibiting the relative strength of the officinal preparations from nux vomica and ignatia seed, and the proportion of strychnia and the alkaloids soluble in water and alkalies which I have classed as brucia.

1. *Six ounces powdered nux vomica, exhausted by displacement with* 80 *per cent. alcohol.*—The tincture was evaporated on the water bath with a little hydrochloric acid to the consistence of treacle. While still warm it was mixed with 50 c.c. of cold water, and the fatty substances allowed to separate by standing; the whole was then filtered, and with the washings diluted to 100 c.c.

20 c.c. of these required for precipitation 21·5 c.c. of mercurial solution, the 100 c.c., or 6 ounces, therefore 107·5 c.c. Hg.

20 c.c. were then given in a 75 c.c. flask, diluted with water to 75 c.c., and then shaken with crystallised caustic baryta in excess. After filtering the alkaline solution, 40 c.c. of it was acidulated with hydrochloric acid, and then precipitated by the mercurial solution; they required 10·3 c.c., or 19·3, for the 75 c.c.—20 c.c. original solution. These 75 c.c. hold in solution strychnia equivalent to 1·63 c.c. mercurial solution, which, deducted from 19·3, leaves 17·67 c.c. as the equivalent of brucia, or 88·35 c.c. in the six ounces. The latter number deducted from the original 107·5 c.c., leaves 19·15 c.c. as the equivalent of strychnia.

The six ounces of nux vomica exhausted by alcohol of 80 per cent., therefore contain—

31·75 grains of brucia,
4·69 „ strychnia.

2. *Six ounces of the same powdered nux vomica exhausted with boiling alcohol of* 80 *per cent., acidulated with hydrochloric acid.*—The tincture from this was treated in precisely the same manner. The fatty substance contained more fluid oil.

They were found to contain—

26·7 grains of brucia,
8·57 „ strychnia.

3. *Tincture of nux vomica*—

225 c.c. contain 2·93 grains of strychnia,
„ 19·5 „ brucia.

4. *Extract of nux vomica*—

5 grammes contain 2·46 grains of strychnia,
„ 7·75 „ brucia.

5. *Extract of nux vomica* (Ph. Boruss)—

4·6 grammes contain 0·7715 grains of strychnia,
„ 13·1155 „ brucia.

6. *Semen ignatiæ*, 2 ounces displaced with alcohol (80 p. c.)—

Yielded 4·93 grains of strychnia,
„ 9·86 „ brucia.

7. *Semen ignatiæ* (the same) 2 ounces extracted with alcohol and hydrochloric acid

Yielded 4·5 grains of strychnia,
„ 13·73 „ brucia.

8. *Extract: Ignatiæ alcohol*, 8·15 grammes

Yielded 4·93 grains of strychnia,
„ 8·42 „ brucia.

PHYSICAL SCIENCE.

On Some Physical Properties of Eugenic Acid, by CHARLES TOMLINSON, *F.C.S.*

IT must be regarded as a curious circumstance that certain liquids of small solubility display some of the motions and other phenomena of camphor on the surface of water. This was first pointed out by Mr. Tomlinson in the case of creosote, and recently in the case of eugenic acid ($C_{10}H_{12}O_{2}$), which displays the phenomena in question in a remarkable manner.

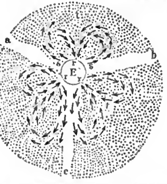
When a drop of eugenic acid is placed on the surface of two fluid ounces of distilled water in a glass capsule two and a-half inches in diameter, it forms a cohesion figure, consisting of a flattened disc of about $\frac{8}{10}$ths or $\frac{8}{10}$ths of an inch in diameter, which sails about on the surface of the water with a vibrating motion of the edge, not nearly so vigorous as the disc of creosote under similar circumstances. The eugenic acid disc often splits up into two or three discs, which revolve round each other, and as they become smaller, move more rapidly, and at length disappear in wild gyrations. The manner in which the disc is disposed of by solution is by throwing off a number of films in rapid succession, which are taken up by the water nearly as fast as they are formed. In this way a repellant action exists all round the disc, which action is at first tolerably equal in all directions, but by exposure to the air certain points of the edge of the disc become resinified, and cease to give off films. These points thus becoming inert assist in the generation of a remarkable series of currents, which set out from the active portions of the disc, and return by a kind of indraw to the inert portions. These currents are often visible by means of the oxidised portions of the films left on the surface, or may be made still more striking by dusting a little lycopodium powder over the surface. A few grains of the powder falling at the edge of the disc will produce physically inert points, and thus assist in the generation of the currents.

Eugenic acid is so little soluble in water, that supposing the first drop to be disposed of in ten minutes in two ounces of water, a second drop may last an hour, a third drop upwards of two hours, while a fourth drop may remain a couple of days on the surface. The time, however, varies with the age of the acid; when newly distilled, it is a little more soluble than when it has been kept some time.

As in the case of the camphor motions, the eugenic acid is more vigorous on a large surface than on a small one, with the same quantity of water. In like manner also anything which diminishes the adhesion of the water checks or arrests the rotations. The currents are very feeble on a solution of common salt or in water containing a little sulphuric acid. The action of small portions of oil in arresting the motions of eugenic acid is the same as in those of camphor. A fixed oil forms a permanent film, and prevents adhesion; a volatile oil, such as turpentine, arrests the motions of the eugenic acid disc only while it is evaporating, or if newly distilled, does not arrest them at all, the eugenic acid skating on the water through the turpentine film, and back again indifferently.

The action of the repellant films given off by the eugenic acid disc is well shown when other films, such as those of turpentine, are placed on the surface. A drop of turpentine gently delivered from the end of a glass rod to the surface on which the eugenic acid disc is floating about, will flash out into a film so as completely to cover the surface, except that part of it occupied by the eugenic acid disc, and a small annular space round it. The eugenic acid disc is struck motionless, but in a few minutes it resumes its activity, invades the turpentine film, and cuts its way through it in all directions. A drop of oil of cubebs does not form a film, but only a flattened disc, in the presence of the eugenic acid disc; the latter, however, soon invades it, drives it about, dashes through it, and disperses it. A drop of oil of bitter almonds is similarly treated.

In the case of the camphor motions, evaporation is as important a function as solution. If the vessel be covered up, or the experiment be conducted in a bottle, the camphor motions and the lycopodium currents produced by the films as they are disengaged in rapid succession, immediately cease. The eugenic acid rotations and currents, on the contrary, can be produced in a covered vessel, and even in a corked bottle, showing that solution is the chief function in the production of these motions. The eugenic acid disc, as soon as it comes in contact with the water, disengages by the adhesion of the water an invisible film, which surrounds the disc, and exerts a repellant action in all directions. This film immediately enters into solution, and gives place to other films, which are similarly disposed of. It is the liberation of this annular film which prevents oils from touching the disc, and produces the repulsion of the lycopodium powder. The first disc of acid is got rid of in this way, and the adhesion of the water is so far impaired that soon after the second drop is placed on the surface the disc forms round it, not an annular film, but portions only of a film, which radiate from the disc in broad lines, *a*, *b*, *c* in the figure. Moreover, the second drop being exposed to the air so much longer than the first, partial resinification sets in at two or more points in the circumference, producing the conditions favourable for the apparent attraction and repulsion of the particles; for if E be the disc, and *a*, *b*, *c* the portions of film given off by it before entering into solution, and *r*, *r*, the resinified points, the radial portions *a*, *b*, *c* drive the particles of lycopodium into the tranquil spaces, *t*, where they get dragged into the currents *s*, *s*, by which they are carried forward in the direction of the arrows. If particles of lycopodium fall on the edge at *r*, *r*, they serve to make those points of the disc inert, and so assist the indraw of the particles towards them. We may also consider the radial portions *a*, *b*, c as being raised above the general surface, in which case, the surface water being driven away, other surface water must flow in to supply its place, and dragging with it the powder, will produce the apparent attractions. The powder often rotates in complete circles or eddies—an effect produced by the particles tending to sink into the lower water by the side of a current that tends to carry it forward; these are just the conditions required for the formation of an eddy.



The currents circulate with considerable rapidity, and are seen in their highest perfection with eugenic acid. They may be noticed feebly if a drop of oil of cloves or of oil of Jamaica pepper be placed on water, and dusted with lycopodium.

King's College, London.

PROCEEDINGS OF SOCIETIES.

CANTOR LECTURES.

"*On Chemistry Applied to the Arts.*" By Dr. F. Crace Calvert, *F.R.S.*, *F.C.S.*

Lecture IV.

Delivered on Thursday Evening, April 21, 1864.

Animal Fatty Matters, the various processes for liberating them from the tissues in which they are contained. Their composition and conversion into soap. Composite candles. The refining of lard. *Cod-liver*, *sperm*, and other oils. *Spermaceti* and wax.

(*Continued from page 56.*)

I have now to draw your attention to a totally different kind of manufacture—viz., that of composite, stearic, and Belmont candles. Many years elapsed between the scientific discovery by M. Chevreul of margaric and stearic acids, and their application to illuminating purposes; for it was early in 1825 that MM. Chevreul and Gay-Lussac took out a patent with a view of realising this advantage. But it was reserved for a manufacturer, M. de Milly, to perfect the manufacturing details of the processes, and to render these candles a marketable commodity. This he effected by also improving the manufacture of the wicks, and he was the first to introduce this article to the trade in 1832, under the name of *bougies de l'etoile*. Let me give you an idea of his *modus operandi*. 100 lbs. of tallow, 17 lbs. of lime previously slaked, and 1000 lbs. of water were placed in a large iron boiler, and kept at the boil for several hours by means of a jet of steam. The result was that the glycerine dissolved in the water, whilst the fatty acids united with the lime. The insoluble stearate, oleate, and margarate of lime were then decomposed by weak vitriol, under the influence of heat. Insoluble sulphate of lime was produced, and the fatty acids liberated. These, in their turn, were submitted to hot and cold pressure, which liberated the oleic acid, leaving the solid stearic and margaric acids behind; it was then only necessary to cast them into moulds containing wicks, and the *bougies de l'etoile* were produced. MM. de Milly and Motard have introduced, of late years, several important improvements into this branch of manufacture, the most important of which is that of operating under pressure, by which means they succeed in decomposing the fatty matters with 3 or 4 per cent. of lime instead of 17, this, of course, involving the saving of a large quantity of vitriol. M. Bouis has made a further improvement by adding to stearic candles 3 or 4 per cent. of sebacic acid, which is extracted from castor-oil, and has the high fusing-point of 261°. M. Chevreul also suggested a simple method of increasing the whiteness of these candles by the addition of a small quantity of ultramarine blue to neutralise the slightly yellow tint of the manufactured acid. One of the greatest improvements in the manufacture of these candles is that carried out by Price's Candle Company; but before describing to you this beautiful process, as adopted by Mr. G. F. Wilson, at this company's works, allow me to state a few facts. Up to 1840 the best kind of candles were those made of spermaceti or of animal fatty matters which were cold and hot-pressed. In that year Mr. Wilson, whilst experimenting with the view of making candles which would not require snuffing, for the illumination on the occasion of her Majesty's marriage, discovered that a combination of cocoanut stearine with stearic acid would make candles giving a beautiful light, and free from the necessity of snuffing. These he called "composite," and they were soon largely sold. In 1838 M. Fremy published his interesting discoveries, showing that when oils or fatty matters were mixed with 20 or 30 per cent. of concentrated sulphuric acid, the fatty matters were split, or, as he calls it, saponified, and that sulpho-margaric, sulpho-stearic, sulpho-oleic, and sulpho-glyceric acids were formed. He further observed that boiling water decomposed the sulpho-stearic and margaric acids, and only partially the sulpho-oleic into stearic, margaric, oleic, and sulphuric acids, which last acid remains in the water together with the sulpho-glyceric acid and that portion of the sulpho-oleic acid not decomposed, the other acids remaining insoluble and floating on the surface. In 1842 Messrs. G. Price and Jones secured a patent to carry out on a practical scale the scientific discoveries of M. Fremy. In that patent two or three important facts are brought out; first, that if instead of operating at a low temperature, as recommended by Fremy, heat was employed, the action of the sulphuric acid on the organic compounds would give rise to sulphurous acid, which they discovered had the remarkable property of converting the liquid oleic acid into a solid acid called "elaidic," thus largely increasing the yield of solid fatty acids. Their mode of operating was this: 10 or 12 per cent. of concentrated sulphuric acid was added to the fatty matters which had been previously liquefied by heat, and the whole was kept at a temperature of 200° for twenty-four hours. During that time the fatty matters were split into their primitive elements, and the oleic acid was converted into elaidic acid. The whole was then repeatedly treated with boiling water, to dissolve the sulpho-glyceric acid and other impurities, leaving the solid fats ready for distillation. Mr. G. F. Wilson has since then greatly improved this part of his manufacture, as the beautiful candles, everywhere to be seen, will amply prove. The most important improvement in a chemical point of view is the following:—He has found, for example, that fatty matters are split up into their component parts by decreasing quantities of vitriol as the temperature used is increased. Thus, at a temperature of 200°, 15 parts of vitriol are required; at 350°, six parts; at 500 one part. Further, by employing this small proportion of sulphuric acid, not only is the expense of washing the fatty matters after their saponification by the acid avoided, but the distillation may be proceeded with in the same vessel. The distillation of fatty matters, first performed by Mr. Wilson, and since carried by him to a state of perfection, is based on the fact that, whilst fatty matters, if distilled by direct heat, are completely decomposed, giving rise to the noxious vapours of acroleine, from the destruction of the glycerine, &c., this evil is completely avoided in distilling them by passing a current of superheated steam at a temperature of between 550° and 600° through the mass of melted fatty matters previously brought to the same temperature. By this means the glycerine passes first without decomposition, and is then followed by the fatty acids. In fact, the distillation proceeds with such rapidity and regularity that a stranger might witness the distillation of 1000 gallons in twenty-four or thirty-six hours, and all the time would probably suppose that water only was distilling. The results are so perfect, that the Jury at the Paris Exhibition of 1855 could hardly credit their genuineness, and actually deputed Mr. Warren de la Rue to come from Paris to verify the fact that the beautiful products exhibited were obtained in many instances from very inferior kinds of fat. The glycerine only requires redistillation to be fit for all the purposes to which it is applied. As to the acids, they are submitted to an intense cold pressure, which separates the oleic acid from the stearic, margaric, or palmitic acids. These are melted, and when near the point of solidification, the vessel containing them is run on rails over the moulds which are so arranged that each frame contains 200 separate moulds, in which already the wicks, prepared with borax or a salt of ammonia, are fixed. The only remaining operation is to fill the moulds and allow the candles to cool.

Oleic acid has recently been made available for several valuable purposes; it has been largely employed in the manufacture of soap; but its most important application as yet is its use on the Continent, and recently in England, as a substitute for olive oil in the greasing of wool for spinning, the advantages of which are marked, as its removal by alkalies in the scouring process is much easier, and its price lower. Messrs. Laing and Wilson have recently taken out a patent for the employment of oleate of ammonia as a mordant; and, as the specimens which I have the pleasure to show you illustrate, it increases in a marked manner the beauty and brilliancy of the coal-tar colours on cotton.

It now only remains for me to refer to another interesting process for splitting fatty matters into their elements, I mean that of M. Tilghman, which consists in mixing fatty matters with one-third to one-half of their bulk of water, and placing them in a vessel capable of resisting a very high pressure. They are submitted to a temperature of between 550° and 600° Fahr., and under the influence of that heat and pressure the fatty matters are decomposed into glycerine and fatty acids. M. Tilghman has also adapted an apparatus which enables him by means of coils of tubes to keep up a constant stream of fatty matters and water through the tubes surrounded by fire, by which means the decomposition is rapidly and continuously carried on. I must not, however, conclude this part of my lecture without drawing your attention to these beautiful specimens illustrating the manufacture of Messrs. Price and Co., kindly lent to me by Mr. G. F. Wilson.

Spermaceti.—This valuable substance is found in large quantities in the bony receptacles of the head of the white whale of the South Seas, and as it is there mixed with a fluid substance called sperm oil, these are separated by means of filtration. The solid mass which is thereby left in the linen bags is first pressed cold, and then between heated plates (hot-pressed). It is then physicked, or heated in a boiler with a solution of caustic potash of specific gravity 1.45, which dissolves a small amount of oily matter, still adhering to the spermaceti, and this, after being well washed, is run into moulds to cool. The manufacture of spermaceti candles requires great care and practical experience. The only fact I shall mention is, that about 3 per cent. of wax is added to spermaceti to prevent the mass being too crystalline or brittle. M. Chevreul, who chemically examined pure spermaceti, or cetine, at the beginning of this century, succeeded in unfolding it into an acid, which he called ethalic acid, very similar to palmitic, and into a neutral substance called ethal, the composition of which, he prognosticated, would be found to contain pure alcohol. This, I am pleased to say, has proved to be the case; for its composition can be considered as represented by—

$$C_{32}H_{33}O_3 + HO.$$

Mr. Heintz has recently published a very elaborate paper on the composition of this substance, and states that spermaceti contains the following components:—

		Ethal or oxide of cetyle.
Stearophanate ..	.. $C_{36}H_{35}O_3$ ..	$C_{32}H_{33}O_3$
Margarate	.. $C_{34}H_{33}O_3$ ..	”
Palmitate	.. $C_{32}H_{31}O_3$ ..	”
Cetate ..	.. $C_{30}H_{29}O_3$ ..	”
Myristate	.. $C_{28}H\ O_3$ ..	”
Create ..	.. $C_{26}H^{2}{}_{5}O_3$ ..	”

It appears to me that several of these products do not exist ready formed in spermaceti, but are the results of chemical reactions.

Bees' Wax.—I have already had the pleasure, at the commencement of this lecture, of drawing your attention to the fact that bees either gather wax from the flowers on which they alight, or are capable of producing it direct from saccharine matters. The wax as it is obtained from the honeycomb being coloured, it is necessary to bleach it for most of the applications which wax receives. The old process (still followed in many parts of Europe) consists in melting wax in water, and allowing it to run into a second vessel, so as to separate it as completely as possible from its impurities. When cooled to nearly its melting point, it is allowed to fall on rollers which revolve in cold water, by which means thin ribbons of wax are obtained, which are then placed on meadows to bleach under the influence of the atmosphere. The above operations are repeated until the wax is perfectly bleached. This plan is so tedious and expensive that several chemical processes have been proposed. M. Casseraud's is, to pass steam through the melted mass, which is, at the same time, subjected to the influence of sun light. Mr. Solly's is, to treat the melted wax by a mixture of nitrate of soda and sulphuric acid, when the nitric acid liberated oxidises and destroys the colouring matters of the wax. Pure wax melts at 149°, and, when treated with alcohol, is found to be composed of—

Cerine or cerotic acid ..	$C_{54}H_{53}O_3,HO$ ..	65
Myricine	$C_{92}H_{92}O_4$ ..	30
Ceroleine	..	5
		100

Sir Benjamin Brodie, who examined most minutely the chemical composition of a great variety of waxes, considers that the substance called by chemists cerine is really cerotic acid, and that myricine is a compound of palmitic acid and melissine. The lecturer here illustrated and explained the various adulterations of wax, giving the means of detecting them. The adulterations were common owing to its value.

Chinese Wax is a compact substance, imported from China, and said to be secreted by an insect called *Coccus Pela sinensis*. This wax, which is harder and more brittle than bees' wax, melts at 181, and has yielded in the hand of the above eminent chemist, cerotic acid and cerotine, or oxide of cerotyle.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture XII. (*Last of the Course*).—*Saturday, January* 30.

Ladies and Gentlemen,—The subject of our lecture to-day is volcanoes, but it is not my intention to present you with any general description of those marvellous and sublime exhibitions of natural forces. No branch of geology is more impressive or more instructive than that which has for its object the study of the results and causes of volcanic activity. In the short space of an hour it would not be possible to enter even upon the threshold, so to speak, of this vast subject. Admirable, comprehensive, and, I may add, thrilling descriptions of active eruptions and their attendant phenomena will be found in many treatises on geology, of which I may especially mention the "Principles" of Sir Charles Lyell. I propose on the present occasion to direct your attention to certain chemical points relating to volcanic action, which, in their bearings upon geological science, will, I trust, prove not unacceptable to you, notwithstanding it will be necessary to cite the results of numerous analyses and of various chemical reactions which do not admit of illustration by striking and attractive experiments on a lecture table. I must rely solely on the intrinsic interest of the subject, and, ladies and gentlemen, I shall do so with confidence.

The elements which chiefly compose the solid matters ejected from volcanoes are oxygen, silicon, aluminium, iron, calcium, magnesium, sodium, and potassium. You will remember that most of these we have passed in review. The other elements are—(I speak now of those which have been clearly detected by chemical analysis)—zirconium in the form of zircon, as in lava at Vesuvius; lithium in a certain variety of palagonite, and of this rock we shall have to speak at length by-and-by;—I give this on the authority of Waltershausen;—boron in the state of boracic acid, in the crater of Vulcano in the Lipari Islands, and also evolved with steam in the fumeroles of Tuscany; chlorine, the chief constituent of the products of sublimation; fluorine, existing in certain volcanic minerals; phosphorus in the lavas of Etna in cavities as phosphate of protoxide of iron, which appears to have been derived from the oxidation of finely-diffused phosphide of iron—at least, such is the theory put forth to account for its presence there; arsenic as realgar—subsulphide of arsenic in the crater of Vulcano, and in the Solfataras; selenium in minute quantity in an orange-coloured variety of sulphur from the crater of Etna; sulphur in all craters, and in the Solfataras; manganese and titanium nearly always, in combination with iron in lavas and volcanic ashes; copper in minute quantity generally; it occurs sometimes in the beautiful form of tenorite in crystalline scales of protoxide; nickel, with traces of cobalt, in olivines; chromium, stated to have been detected in small quantity in a variety of palagonite, vanadium, in minute quantity, but distinctly in an Iceland chlorite. Traces of zinc are reported to have been found in certain sublimed products in Monte-Rosso. Tin has been discovered in the crata of Etna; lead as galena in the rock of Monte Somma, and as chloride of lead in the crater of Vesuvius, and also in sublimed products of Monte-Rosso in combination with protoxide of copper and traces of silver. The elements evolved in the state of gas will be presently enumerated.

According to Bunsen, notwithstanding the great diversity in the mineralogical characters and chemical composition of the rocks of Iceland, all the eruptive masses there, from the most ancient to the most recent, consist either of one or two typical minerals or rocks, or of various mixtures of these two—namely, what he terms the normal trachytic and the normal pyroxenic. On these points I must beg your most particular attention. It leads to a wide and, it may be, a very important generalisation. All these rocks, then, he maintains, may be reduced to two typical rocks, or to various mixtures of these rocks—that is to say, any rock analysed, if not composed of one or the other may be represented by definite mixtures of these two rocks. That is the point. From the result of numerous analyses the mean composition of these rocks was found to be this,—

	Normal trachytic.	Normal pyroxenic.
Silica	76·67	48·47
Alumina and protoxide of iron . . .	14·23	30·16
Lime	1·44	11·87
Magnesia . . .	0·28	6·89
Potash. . . .	3·20	0·65
Soda	4·18	1·96
	100·00	100·00

You see that what Bunsen designates as the normal trachytic rock is rich in silica, the proportion being large. The opposite extreme, or that which is poorest in silica, is the pyroxenic. You see how much larger the proportion of alumina and iron is in this case. This rock is especially rich in lime. Magnesia is also in large quantity. The ratio between the oxygen of the silica and that of the bases in the first series—the trachytic type—is as 3 to 0·596. The ratio of the oxygen of the silica to that of the bases in the normal pyroxenic is as 3 to 1·998, or very nearly 2. Although there are other unaltered rocks of Iceland, or non-metamorphosed rocks, in the composition of which none of these ratios exist, yet it may be shown notwithstanding that in all these rocks the oxygen in the bases ranges from 0·579 to 1·948 for every three of oxygen. I wish you to understand that point clearly. It may be shewn that the oxgen of the bases ranges between the numbers which I have placed before you. This is done by a very simple calculation: from the ultimate composition of any of the unchanged Icelandic rocks, the proportions in which the trachytic and pyroxenic rocks should be mixed to agree with that composition is very readily deduced. Numerous varieties of these rocks have been analysed by Bunsen, and he assures us—and his analyses prove what he says—that there is not one in which the results differ from the calculated composition to a greater extent than might reasonably be expected in such a calculation based merely on the mean results of analyses.

This general induction applies also to the rock formations upon the lava streams of the Icelandic volcanoes. The typical rocks and the rocks resulting from their intermixture exist in these most modern formations. The blackish-grey stony lava of which he speaks on the south eastern foot of the Krafla, and the beds of obsidian alternating within it, have exactly the same composition as the normal trachytic mass.

	Stony lava.	Obsidian.
Silica	75·12	75·28
Alumina . . .	11·34	10·22
Protoxide of iron .	3·92	4·24
Lime	1·73	1·81
Magnesia . . .	0·39	0·25
Potash . . .	1·85	2·44
Soda	4·39	5·53
Water	0·41	0·23
	100·00	100·00

These two analyses—that of the stone-like lava and the vitreous lava or obsidian—when placed side by side, agree so exactly that you would be inclined to suppose that the analyses referred to the same specimens. The analysis I have given of the trachytic rock very nearly represents the composition of these two kinds of lava. The streams of obsidian on the north-eastern declivity of Hecla approach very nearly in composition to that which I have stated, and may be represented as composed of 1 part of the trachytic rock to 0·2325 of the normal pyroxenic. We now pass on to the typical pyroxenic rock, or the extreme basic rock—that which contains the least silica and the most base. This is represented in the substance of the great lava streams which flow west-north-west from Hecla to the banks of the Thjórsá. The composition found by analysis is nearly identical with that of the normal pyroxenic type. The lavas from the western foot of Hecla may be represented as composed of mixtures of these two typical rocks in the following proportions:—

	Trachytic.	Pyroxenic.
Lava at Hals.	1	2·77
Efrahools lava	1	1·568
Ash of Hecla from the eruption, 1845	1	2·402

The order which is here given is that of the succession of the streams examined, from the more ancient to the younger. Hence it is inferred by Bunsen that "the flow from the two volcanic foci which maintained the activity of the volcano is as irregular as the activity itself." He extends his induction beyond the limits of Iceland, and in proof of its correctness adduces the results of analyses of non-metamorphosed volcanic products from various parts of the world. From a special investigation of the volcanic system forming the high table-land of Armenia, he concludes that the matters composing these rocks have flowed from sources chemically identical with those of Iceland; and he suggests the idea that all the volcanic formations on the earth's surface have originated from chemically-identical sources. This is a very large induction, and it requires a vastly greater number of experiments to justify our unqualified reception of it.

The subject we have next to consider is the volcanic tufa, or "tuff," as it is commonly called. It is defined by Sir Charles Lyell as "an Italian name for a variety of volcanic rock of an earthy texture, seldom very compact, and composed of an agglutination of fragments of scoriæ and loose materials ejected from a volcano." The tuff is the result of the greater or less degree of agglutination of volcanic ash. In Iceland the so-called palagonite tuff is stated to be the most ancient of the volcanic series there. Its formation was immediately followed by the elevation of trachyte and clinkstone, or, as it is termed, phonolite, from the ring which it gives when struck. Then comes the penetration of the older amygdaloidal trap, which appears in large veins far extending laterally through the tuffaceous masses. Next, the olivine and basaltic masses penetrated the trap formations in systems of veins of different ages. The series of plutonic elevations, it is stated, closes with the fifth period of the older or more recent lavas.

The mineralogical characters of palagonite, which is recognised as a distinct mineral species, may be stated to be the following:—"Its colour varies from amber-yellow to colophany brown; it is inferior in hardness to calcspar, and it is amorphous in structure." The palagonite tuff is composed of silicates decomposable by acids, and of others which are not so decomposable. These consist chiefly of augite and a difficultly-decomposible felspar, or a mixture of both, resulting from fusion, and forming trap or basalt. The fragments of basalt are sometimes a foot in diameter, and sometimes so small as even to be invisible to the naked eye. Occasionally small crystals of felspar or green or black augite are found in it, and the so-called sidero-melan of Waltershausen, which occurs in small globules, and may be regarded as nothing more than a fused, highly-ferriferous variety of felspar termed labradorite. The composition of felspar may be represented, according to Bunsen, by the formula—

$$3RO,2SiO_3+2(R_2O_3,SiO_3)+9HO.$$

The RO represents the lime series of bases—lime, magnesia, protoxide of iron, potash, or soda. You will recognise in the first part of the formula ($3RO,2SiO_3$) our old friend Wollastonite. The term R_2O_3 represents alumina, the alumina being partially replaced, it may be, by peroxide of iron. This substance of the alumina series is in combination with silica, forming a silicate, the oxygen of the base being equal to that of the acid. It is important to note this formula especially. Perhaps you would like to have a record of one analysis of palagonite, so I will give it. A great number of analyses of it from different localities have been made, which you will find recorded in Waltershausen's work on "Volcanoes," and also in Rammelsberg's "Dictionary of Mineral Chemistry," both in German. All the analyses are there collected.

Analysis of Iceland Palagonite by Bunsen.

Silica	37·417
Peroxide of iron . . .	14·175
Alumina	11·165
Lime	8·766
Magnesia	6·036
Potash	0·685
Soda	0·652
Water	17·152
Insoluble residue . . .	4·108
	100·156

This rock is derived entirely from metamorphic action. Please to note the fact that the iron compound is the peroxide, and not the protoxide. This singular cementing rock, palagonite, is, as you see, a hydrated compound, containing about 17 per cent. of water.

The palagonite tuff consists of a mixture of anhydrous and hydrated silicates. It is asserted that the anhydrous silicates—those free from water—belong exclusively to the pyroxenic rocks, and are never accompanied by trachytic masses, or even replaced by them. The hydrated silicates which generally cement together the fragmentary rock may be regarded as a mixture or combination of two silicates, one of which has the formula, $3RO, 2SiO_3 + \text{Water}$, and the other of which has the formula, $Al_2O_3SiO_3$. The palagonite substance appears to occur everywhere as a characteristic constituent of tuff when the pyroxenic rocks are especially well developed. It is met with in the more considerable basaltic elevations of Germany and France, on Etna, in the Azores, in the Galapagos Islands, the Cape de Verde Islands, and elsewhere. Bunsen gives analyses of the palagonite, or the cementing matter of the tuff, from various parts of Iceland, from which it appears that the composition is very uniform, the oxygen of the alumina series of bases being about half that of the silica, and the oxygen of the lime series of bases being about half that of the alumina. Analyses of palagonite occurring in the Cape de Verde Islands, the Azores, the Canaries, and in the basaltic formations of Germany, led to the same result. Its composition is deduced from a great variety of analyses. Several analyses of the material from various parts of the world lead to the conclusion that its composition may be precisely represented as a hydrated pyroxenic rock. That is a very curious and important chemical fact. Bunsen arrived at the conclusion that a palagonite substance may result from the action of lime on pyroxenic rock at a high temperature. He cites the observation of Darwin on basaltic lava which had run over a recent deposit of limestone. The product of this mutual action is described as a breccia-like conglomerate, in which the altered lava is mixed with a very pure mass of carbonate of lime. The mixture, he says, had the appearance of having been kneaded in a pasty state, which, according to Bunsen, excludes the possibility of supposing that fragments of the limestone accompanying the lava had originated from subsequent infiltration. "The chemical change," he says, "which has resulted from the contact of the limestone with the lava does not leave any doubt as to the nature of the process by which the palagonite has been formed. Wherever the lava is in contact with the limestone it is converted into a mass presenting all the mineralogical characters and chemical reactions of palagonite; and this metamorphism, characterised by a gradual transition into the unaltered rock, is more fully developed where the calcareous substance preponderates over the constituents of the mass." We shall examine this theory directly. An analysis is then given to show that the metamorphosed lava scarcely differs in composition from palagonite. He tells us that he has been able to recognise perfectly analogous though not identical relations by observation and experiment on basaltic dykes traversing limestone. Then he mentions tuffs from various and remote localities, which, he maintains, prove in the most decisive manner that palagonite may be generated as I have described. He actually produced palagonite by heating basalt in molten potash, when hydrogen was evolved, owing to the peroxidation of the protoxide of iron existing in basalt at the expense of the oxygen of the water. When steam at a high temperature is brought in contact with this rock the protoxide of iron is peroxidised by the oxygen of the steam, and hydrogen in equivalent proportion is liberated. Bunsen also obtained palagonite by igniting an intimate mixture of one part of finely-powdered basalt and thirteen parts of slaked lime, and elutriating or washing the product, which consisted of a mixture of lime and palagonite; and this palagonite was recognised under the microscope by its peculiar characteristics. Here, then, is apparently experimental proof of the foundation of this rock in the laboratory by heating a mixture of basalt and slaked lime; but Bunsen is obliged to admit that lime cannot have been an agent in the formation of most palagonites, especially this of Iceland, because carbonate of lime scarcely ever occurs as a constituent of the undecomposed palagonites of Iceland, and because the percentage of lime in the mineral itself calculated as anhydrous does not equal the percentage of the same constituent in the normal pyroxenic rocks. He is, therefore, driven to the assumption that fixed alkalies, and not lime, were the agents of the transformation—an assumption which involves another, namely, that there existed a third kind of normal volcanic rock abounding in an alkaline base. This is a pure assumption, one assumption being required to explain the other. Admitting the assumption that the palagonite might have been formed in that way, he thinks that the alkali may have been volatilised from the supposed rock "while in a state of igneous fusion," and, as an argument in support of this, he adduces the fact of the volatilisation of potash in our iron-smelting furnaces; but I submit that this is not the simple case of separation of potash from its combination with silica by the mere action of heat. In the blast furnace there is a large excess of an extremely fixed base, namely, lime, which has a tendency to combine with silica and displace the potash, and under these circumstances it is in nowise difficult to account for the volatilisation of the potash. I am not aware that it has been shown that silicate of potash, rich in silica, has been decomposed by heat alone. In the blast furnace there would be not only lime present, but also alumina. I maintain, therefore, that the illustration drawn by Bunsen from what occurs in our blast furnaces cannot occur in these natural phenomena. In the localities referred to by Bunsen no such conditions have been shown to obtain, or can obtain. With reference to the alleged action of lime I would ask, even if the limestone were there to supply the material, is it conceivable that intermixture in any sensible degree of the bases with viscid lava could possibly take place? Bunsen's laboratory experiment of heating one part of finely-powdered basalt in intimate mixture with thirteen parts of slaked lime, was made under circumstances which it is certain could never have been approximately imitated in nature. He has, therefore, failed to present us with any more satisfactory foundation for his views concerning the formation of palagonite than mere assumptions which seem to be an absolute contradiction to the phenomena observed in nature. Waltershausen entertains the opinion that palagonite has been formed on the bed of the sea, on which volcanic ash has subsided. He lays stress on the comparatively large proportion of magnesia contained in palagonite, and accounts for this by the action of the magnesian salts of the sea-water.

Let us next direct our attention to the gases evolved by volcanic action. A prodigious evolution of gaseous matter, or vaporous matter, or both, takes place from volcanoes in activity, and a very large proportion of these matters is certainly steam, or the vapour of water. The nature of the exhalations cannot, of course, be ascertained directly, but must be inferred from that of the gaseous matter which we are able to collect, and which escapes under conditions differing very much in degree from those which obtain during active volcanic operations, or, in other words, during the process of eruption. Gas is evolved from what are called volcanic vents or fumeroles, which are often so small as to be imperceptible. "Fumeroles" is the common expression by which these vents are designated now-a-days. "Gas springs" we may term them. They become visible by the condensation of the aqueous vapour or steam which comes out, or by the precipitation of sulphur in a minutely-divided state, or by the deposition of other solid or liquid matter which may have been carried upwards from other subterranean recesses. The gases of volcanoes have been investigated by Bunsen, by Charles Sainte-Claire Deville (brother of the aluminium Deville), and by Leblanc. They have devoted special attention to the study of the composition of volcanic exhalations, which we will now pass in review.

Aqueous vapour is stated to constitute the chief part of the exhalations from volcanic vents. We well know, also, that instances are recorded in which liquid water has been thrown out in torrents. There is one case in which even dead fish are reported to have been ejected, thus proving that in that case a sudden irruption of surface water into the subterranean cavities must have taken place.

Free hydrogen appears as a constituent in many analyses. A very large proportion was found by Bunsen in the gas from the smoking muddy soil of a large fumerole in the far north of Iceland. The proportion of hydrogen is very large, and it well deserves attention. I stated just now incidentally how hydrogen might be produced by the action of the vapour of water on basalt at a high temperature, the protoxide of iron being peroxidised at the expense of the water, with the liberation of hydrogen. The composition of the gas examined by Bunsen from this smoking muddy soil of the fumerole was—

Nitrogen	0·72
Carbonic acid	50·00
Sulphuretted hydrogen . . .	24·12
Free hydrogen	25·14
Making a total of . . .	99·98

Deville found hydrogen in the gas escaping from the liquid lava of Vesuvius, thrown out in the eruption in the winter of 1861-2.

Carburetted hydrogen, or marsh gas, was very carefully sought for by Bunsen, who failed to detect any evidence of its presence—at all events, in the gases of Iceland, and he came to this conclusion—(these are his own words)—"Volcanic gases are characterised by the absence of all combustible carbonaceous substances." That, if it were correct, would be a very important conclusion. I have no doubt that it is correct as far as Bunsen's observations extend. Deville, on the other hand, informs us that he found marsh gas in the gas evolved from the liquid lava of Vesuvius, thrown out in 1861, and also a very large proportion in gas of fumeroles in the vicinity of Etna. The gas collected in June from the little cones, which together constitute the Macaluba of Girgenti, was composed of—

Carbonic acid	1·15
Oxygen	1·70
Nitrogen	6·75
Marsh gas (the gas escaping from marshes).	90·40
	100·00

He gives us many other analyses, but I give you that in which the hydrocarbon appears to the largest extent. Waltershausen informs us of the occurrence of rock oil or naphtha in clear drops in certain drusy cavities and holes in a doleritic basalt near Paterno, at the foot of Etna. The lava, moreover, which he saw erupted several days in November, 1838, from the crater of Etna, he assures us, smelt very strongly of naphtha.

Carbonic acid is a general constituent of volcanic gases. I have already mentioned its occurrence in two or three places.

Hydrochloric acid appears to be a very frequent constituent of volcanic exhalations. From Vesuvius, especially, it has been largely evolved, and also from Etna, though in less proportion. In Iceland Bunsen was able to detect only traces of it in a free state in the crater fumeroles—that is to say, the fumeroles or volcanic vents in the crater—a few months old. It is reported—(this is a singular statement, if correct)—that no hydrochloric acid has been found in the gas from the volcanos of South America. The proportion of this gas in volcanic exhalations has been found to rapidly decrease after the cessation of an eruption. There is no difficulty in accounting for the evolution of hydrochloric acid if we can only ensure this condition—exposure of an alkaline chloride intermixed with silica to the vapour of water at a high temperature. For instance, if we take common salt and mix it with silica, and then put the mixture in a porcelain tube and expose it to a red heat, and pass steam over it, we can evolve hydrochloric acid in torrents. The water is decomposed, the oxygen of the water oxidises the sodium of the chloride of sodium or common salt, producing soda, which combines with the silica, forming silicate of soda; and the hydrogen of the water combines with the chlorine of the chloride of sodium, forming hydrochloric acid, which passes off.

I will give one or two statements concerning the fumeroles of the eastern edge of the great crater of Vesuvius of 1850, as recorded by Deville. The maximum of intensity was towards September, 1855. Gases then escaped at a very high temperature and under pretty strong pressure. There were sulphurous acid and hydrochloric acid, and the relation of the hydrochloric acid to the sulphorous acid was as 86·2 to 13·8. In June, 1855, the simple condensation of the same acid vapours indicated that they consisted almost entirely of water, containing 99·9 per cent. The observations concerning temperature are interesting. The maximum temperatures of these fumeroles were as follows:—

In May, 1855,	during the	eruption,	85°	Centigrade.
In June, 1855,	"	"	90°	"
In Sept., 1855,	"	"	180°	"
In June, 1856,	"	"	154°	"

The gas collected in June, 1856, always contained water in large proportion. Making a deduction for that water, the remaining gas consisted of—

Sulphurous acid	2·6
Oxygen	18·7
Nitrogen	78·7
	100·0

This composition shows clearly that atmospheric air must have had free access.

Sulphurous acid appears to be universally present in the gaseous evolutions from volcanoes. Bunsen found 1·54 per cent. in the gas from a vent in the great crater of Hecla; but in the gases from vents in the lava streams he could not detect it, and scarcely at all in the condensed vapour of those gases. We shall presently consider its possible source and mode of generation.

(To be continued.)

LECTURES ON CHEMICAL PHILOSOPHY.—II.

Delivered at the College of France, by M. A. WURTZ.

(Continued from page 57.)

We have first the *law of specific heats.* This law, established by Dulong and Petit, may be thus stated:—When we multiply the atomic weights of simple bodies by their specific heats we obtain a constant product. This is the same as saying that the quantities of each element representing their atomic weights have the same specific heat, or, rather, that all simple bodies have the same *atomic heat.*

There are, however, some exceptions to this law. Boron, silicium, and carbon have an atomic heat completely discordant with the law. We shall examine this anomaly further on.

Our atomic weights, identical with those of Berzelius (with the exceptions of the four metals lithium, sodium, potassium, and silver, which we halve), are, for the most part, double the equivalents. These atomic weights are also in harmony with the *law of isomorphism.* Thus, for example, Gerhardt represented by Cu_2S the cuprous sulphide isomorphous with the sulphide of silver Ag_2S.

Cuprous sulphide should be written with the new numbers Cu_2S, a formula analogous to Ag_2S, as the law requires.

But isomorphism is only a secondary matter; the real foundation of the atomic notation is the law of Gay-Lussac, relative to the combinations of gases. It results from this law that the densities of gases and vapours are proportional to their atomic weights, and hence it follows that if we bring these densities into relation with that of hydrogen taken as unity, the same numbers will represent both the atomic weights and the densities.

The following diagram will make these relations clear:—

Simple bodies.	Densities in relation to air.	Densities in relation to hydrogen.	Atomic weights.
Hydrogen . .	0·0693	1	1
Oxygen . .	1·1056	15·9	16
Nitrogen . .	0·9714	14·0	14
Sulphur (at 1000° C.)	2·22	32·0	32
Chlorine . .	2·44	35·2	35·5
Iodine . . .	3·716	125·8	127·

To calculate the density of a gas in relation to that of hydrogen taken as unity, it is only necessary to multiply the density in relation to air by $\frac{1}{0{\cdot}0693} = 14{\cdot}14$, the density of air in relation to that of hydrogen. We thus obtain numbers identical with those which stand on the diagram as the atomic weights.

There are some exceptions to this law also, and these we shall study presently.

And now having confirmed our system of atomic weights so far as regards simple gases, let us proceed to study it in relation to compound bodies, and see how we may deduce the atomic weights of these from their densities.

The relations which exist between the atomic, or rather the molecular weights of compound gases and their densities are of the most simple nature. We may express them by saying that *equal volumes of compound gases contain the same number of molecules.* It follows that the weights of the molecules are proportional to the densities. Here we have for the first time the notion of a *molecule.*

Let us consider hydrochloric acid—it contains equal volumes of chlorine and hydrogen. Two volumes of HCl contain 1 volume of Cl and 1 volume of H. If the volumes were atoms, we may say that 2 atoms of HCl contain 1 atom of Cl + 1 atom of H. Well, the union of these two atoms forms a molecule of HCl.

Two volumes of ammonia contain 3 volumes of H + 1 volume of N.; then 2 atoms of ammonia contain 3 atoms of H + 1 atom of N.

We know further that 2 volumes of ammonia combine with 2 volumes of HCl, which leads us to consider the quantities of HCl containing 1 atom of H + 1 atom of Cl, and corresponding to 2 volumes as equivalent to the quantity of ammonia containing 1 atom of N and 3 atoms of H, and also corresponding to 2 volumes. Both these quantities represent *molecules* of the compound gases. We may extend the same consideration to other compound gases, and see that if the weights of the atoms represent the weights of volumes, the molecular weights or the weights of the molecules will represent the weights of 2 volumes.

The *molecule* representing 2 volumes is the smallest quantity of a compound body which can exist in a free state, or can enter into or be withdrawn from a compound, while an *atom* is the smallest quantity of an element which can exist in a compound body.

We have shown that the molecular weights of compound gases are proportional to their densities. If the densities of these gases were brought into relation with hydrogen taken as unity, it would only be necessary to double the numbers to obtain the molecular weights. The density, in fact, represents the weight of one volume, and the molecular weight represents two volumes.

To find the molecular weights, then, we have only to multiply the densities in relation to air by

$$\frac{1}{2 \times 0{\cdot}0693} = 28{\cdot}88$$

or twice the relation of the density of air to the density of hydrogen.

Let us make the calculation for some compounds, and also for some elements, and so verify the law and its consequences.

	Density in relation to air.	Double density H=1.	Molecular weights.	Symbol.
Hydrogen . .	0·0693	2	2	H_2
Chlorine . .	2·44	70·5	71	Cl_2
Bromine . .	5·54	159·0	160	Br_2
Iodine . . .	8·716	251·7	254	I_2
Cyanogen . .	1·806	52·1	52	Cy_2
Methyl . . .	1·0365	29·9	30	Me_2
Hydride of methyl	0·558	16·1	16	MeH
Ethyl . . .	2·0462	59·09	58	Et_2
Oxygen . . .	1·1056	31·9	32	O_2
Sulphur (at 1000°).	2·22	63·5	64	S_2
Water . . .	0·6235	18·0	18	H_2O
Sulphuretted hydrogen . . .	1·1912	34·4	34	H_2S
Sulphurous acid .	2·234	64·5	64	SO_2
Nitrogen . .	0·9714	28·0	28	N_2
Protoxide of nitrogen . . .	1·527	44·1	44	N_2O
Binoxide of nitrogen	1·038	29·98	30	NO
Methylamine. .	1·08	31·19	31	NMe_3
Ammonia . .	0·591	17·07	17	NH_3
Phosphorus . .	4·42	127·6	62	P_4
Phosphuretted hydrogen . .	1·184	34·2	34	PH_3
Protochloride of phosphorus. .	4·472	136·9	137·5	PCl_3
Arsenic . . .	10·6	306	150	As_4
Arseniuretted hydrogen . .	2·695	77·8	78	AsH_3
Chloride of arsenic .	6·3006	181·9	181·5	$AsCl_3$
Chloride of silicium	5·939	171·5	170	$SiCl_2$
Mercury. . .	6·976	201·4	100	Hg
Mercuric chloride .	9·8	283	271	$HgCl_2$
Cadmium . .	3·84	12	56	Cd
Carbonic oxide .	0·967	27·9	28	Co
Carbonic acid .	1·529	44·1	44	Co_2
Marsh gas . .	0·559	16·1	16	CH_4
Ethylene . .	0·9784	28·2	28	$(C_2H_4)''$
Chloride of ethylene	3·4434	99·4	99	$(C_2H_4)''Cl_2$

This diagram shows us the exceptions to the law of Ampère we have already alluded to. In the next lecture we shall continue the study of this law and discuss the exceptions.

ACADEMY OF SCIENCES.

July 25.

MM. H. Deville and Troost, in continuation of their experiments on the means of determining high temperatures, describe a porcelain apparatus by which they measured a temperature reaching as high as 1530° C. The description is too long to be given here, but the account leaves no doubt that we have now a "pyrometer capable of giving indications of great exactness, and of receiving important applications." We may add that at the temperature given above copper and silver seemed to be vaporised, and feldspar was fused to a perfectly clear glass. An iron nail, however, showed no signs of fusion.

Father Secchi has continued his observations on the atmospheric lines of the planets. Taking advantage of the moon being in the neighbourhood of Jupiter and Saturn, he compared the spectra of the three, and satisfactorily made out the presence of the atmospheric lines in the spectra of the planets, and the absence of them in that of the moon.

M. Margueritte, in another note "*On the Carburation of Iron by Carbonic Oxide,*" details some experiments which leave no doubt on his mind that iron is cemented by carbonic oxide,end that the presence of nitrogen is not indispensable. After procuring pure iron by reducing tha oxalate in a current of hydrogen, he calcined it in presence of pure carbonic oxide, and found that carbonio acid was evolved, and the weight of the iron (which was completely converted into steel) increased.

M. Hautefeuille gives an account of a "*Method of Producing Artificially Crystals of Anastase, Brookite, and Rutile.*" These were formed by heating finorida of titanium to different temperatures in the presence of aqueous vapour.

In a paper "*On the Production of Ammonio-Magnesian Phosphate,*" M. Lesieur shows that this salt is produced when ammonia is added to a phosphate of magnesia, or magnesia is added to acid phosphate of ammonia. The announcement of these facts no doubt startled the chemists present at the meeting.

M. Millon also announced a great discovery. In a note "*On a New Means of Destroying Organic Matter Present with Mineral Matters,*" he states that if the mixed substances are first heated in a retort with sulphuric acid, and then ignited in e platinum crucible, nitric acid being dropped in occasionally, the organic matters will be completely hurned away, and a perfectly white residue left. Tha author is at the pains to add that, under these circumstances, carbonates, chlorides, iodides and bromides, and organic salts ara destroyed, and sulphates left in thair place.

M. Maumené presented a second memoir on "*A General Theory of the Exercisa of Affinity.*" The anthor does not believe in types nor in substitutions. As we shall shortly have M. Wurtz's lecture on the subject, we will leeve M. Maomené's reasons for the present.

We recently announced that M. Bechamp had discovered a new hydrocarbon in coal-tar. M. Nequet now comes forward and claims the discovery as well, and, being further advanced with its examination, gives the formula as C_9H_{12}. The author has commenced a series of comparative experiments with the new body, and with cumene procured from cuminic acid, and also with mesitylene from acetone.

MM. De Vry and Alluard puhlish a paper "*On the Rotatory Power of Quinine.*" They compared the best quinina of commerce with pure quinine made by themselves, and found, as might be expected, that the polarising apparatus revealed the presence of impurities when in too small quantities to be detected by chemical processes. The experiments were undertaken in consequenca of tha authors having found the determinations of Bouchardat incorrect. Tha reader interested in this subject will find full particulars of tha experiments in this paper.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1229. Louis Bricout, Rheims, France, "Improvements in apperatus employed in carburetting gas."—Petition recorded May 14, 1864.

1624. Charles Frielinghans, King Street, Cheapside, London, "Improvements in the manufacture of starch and yeast, and the machinery employed therein."—A communication from Ignats Ben, of Nedingen, Prussia.—Petition recorded June 29, 1864.

1631. John Corby, Dunoon, Argyleshire, N.B., "Improvements in centrifugal machines, such as ere used for separating syrup from sugar, and in apparatus for making the same."—Petition recorded June 3c, 1864.

1656. Samuel Fox, Deepcar, near Sheffield, "Improvements in treating slags or cinders in order to ohtain or produce cast steel therefrom."—Petition recorded July 2, 1864.

1663. George Holworthy Palmer, Queen's Crescent, Haverstock Hill, Middlesex, "Improvements in apparatus for heating and evaporating liquids and fluids."

1668. William Lloyd, Dartmouth Street, Westminster, "Improvaments in the manufacture of hydro-carbon gas, and in apparatus employed therein."—A communication from William Henderson, Valparaiso, South America.—Petitions recorded July 5, 1864.

1686. John Henry Johnson, Lincoln's Inn Fields, "Improvements in the smelting or reducing of lead ores, and in the refining and softening of lead."—A communication from Prof. Alexander Hill Everett, New York, U.S.A.

1691. James Wilson, Exeter, Devonshire, "Improvements in tanning, and in the machinery or apparatus employed therein."—Petitions recorded July 7, 1864.

1694. Louis Henry Gustavus Ehrhardt, Richmond Road, Bayswater, Middlesex, "An improved gunpowder."

1695. Alfred Blake, Castle Brewery, Nawport, Monmouthshire, "Improving water for the purposes of hrewing, and beer produced therefrom."

1701. Abraham Rogers, New Wortley, near Leeds, Yorkshire, "Improvements in the means or apparatus for supplying fuel or heat to steam boilers or other furnaces, applicable also for ventilating mines and similar purposes."—Petitions recorded July 8, 1864.

1705. Jean Joseph Montié, Paris, France, "Improvements in distilling apparatus suitable for rectifying, separating, or combining, with other suitable matters, benzol, petroleum, or other more or less volatila hydrocarbons or their derivatives, concentrating acids, treating alcoholic products, or other similar purposes.

1709. George William Wyckeham Webbe and Frederick Cant, Croxted Road, Dulwich, Surrey, "Improvements in the manufacture of paints."—Petitions recorded July 9, 1864."

1714. Jonathan Wright Horsfall, Longwood Avenue, Dublin, "Improvements in the manufacture of peat, coal, or fuel."

1727. Stephen Carey, East Ham, Essex, "Improvements in apparatus for calcining hones, and for reburning and revivifying animal charcoal."

1729. Ludwig Schad, Cassel, in the Electorate of Hesse, "Improvements in the manufacture of pigments."

1732. John Forbes, Perth, N.B., "Improvements in distilling liquids, and in tha machinery, apparatus, or means employed therefor."—Petitions recorded July 12, 1864.

1759. Alexander Angus Croll, Coleman Street, London, "Improvements in the manufactura or preparation of material for the purification of gas."—Petition recorded July 14, 1864.

1813. William Edward Newton, Chancery Lane, Middlesex, "Improvements in the manufactura of and mode of applying explosive compounds."—A communication from Alfred Nobel, Héleneborg, Stockholm, Sweden.—Petition recorded July 20, 1864.

Notices to Proceed.

1232. Joshua Womersley, Norwich, "Improvements in the manufacture of paper from certain fibrous substances."—Petition recorded May 16, 1864.

1301. John Baird and John McIntyre, Alexandria, Dumbartonshire, N.B., "Cartain improvements in apparatus employed for clearing and bleaching textile fabrics."—Petition recorded May 25, 1864.

1545. James Forbes, Old Ford, Bow, Middlesex, "Improvements in the means of, and apparatus for manufacturing sulphate of ammonia and sulphuric acid."—Petition recorded June 21, 1864.

1564. George Haseltine, Southampton Buildings, Chancery Lane, Middlesex, "Improvements in epparetus for-smelting and reducing ores and metals."—A communication from Loomis George Marshall, Philadelphia, Pennsylvania, U.S.A.

629. Louis Adolphus Durrieu, Soho Square, Middlesex, "Improvements in the method of clearing or causing to disappear from wool, woollen yarn, woollen fabrics, mixed woven fabrics, or felted cloths or fabrics, the specks caused by particles of matter in wool or fabrics, above-mentioned, and other blemishes which do not receive the dye equally with the general body of the fabric or substance."—A communication from François Romain Joly, Gaillon (Eure), France.—Petition recorded March 12, 1864.

690. Louis Adolphe Durrieu, Soho Square, Middlesex, "Improvements in the dyeing of woollen and other fabrics."—A communication from Louis Gouchou, Lisieux, France.

721. John Leslie, Conduit Street, Hanover Square, Middlesex, "Improvements in apparatus for generating heat."—Petition recorded March 22, 1864.

754. Richard Archibald Brooman, Fleet Street, London, "An improved method of, and improved apparatus for, revivifying animal black."—A communication from Jean Baptiste Felix Trolliet, Lyons, France.—Petition recorded March 26, 1864.

993. D'Herman Lomer, Brussels, Belgium, "Obtaining colouring matter as substitute for aniline colours."—Petition recorded April 21, 1864.

1631. John Corby, Dunvoo, Argyleshire, N.B., "Improvements in centrifugal machines, such as are used, for separating syrup from sugar, and in apparatus for making the same."—Petition recorded June 30, 1864.

CORRESPONDENCE.

Deposit of the Nile.

To the Editor of the CHEMICAL NEWS.

SIR,—Some relatives of mine have lately returned from the Nile, and brought some of the *mud* that is deposited by the water of that famous river. It may interest some of your readers to know that it is constituted as follows, after being subjected to a qualitative analysis:—Principal constituents: silicic acid, alumina, proto and sesquioxide of iron, with traces of phosphate of alumina, and organic matter containing ammonia. I am, &c.

SHERIDAN MUSPRATT, Ph.D.

College of Chemistry, Liverpool, July 17.

Science in Courts of Law.

To the Editor of the CHEMICAL NEWS.

SIR,—Patent cases often involve scientific questions, and, perhaps, more than any other kind of cases, demand some knowledge of science from the tribunal which should try them. On these grounds it is now pretty generally admitted that they are not suited to the capacity of juries, and trial before a judge without a jury has come to be the order of the day.

At first sight one would very naturally be inclined to regard this as an improvement; but any such notion will be dispelled by a little reflection, and still more completely by a review of the actual cases which have been tried under the new arrangement.

In truth, we could hardly expect the judge to be less ignorant of science than the juryman. The judge will be found rather more facile in his expression of ignorance than the juryman; but one is about as devoid as the other of the necessary scientific culture.

The justice of these remarks is very strikingly brought out by the recent "Magenta" trial, Simpson *v.* Holliday. In his judgment on this case the judge had occasion to speak of the mixture of an aqueous solution of arsenic acid with aniline—*i.e.*, of the aqueous solution of arseniate of aniline. He delivered himself in the following manner:—"You cannot get *colour*[*] above 212° until all the water has gone out, because as long as free water is there—not in combination, making a hydrate—as long as it is not water of combination, but merely the water of solution, until you have got off that water of solution the vapour keeps down the heat you apply to the boiling point, which is 212°. Therefore, you have to get rid of all that before the process takes place. Dr. Hofmann explained that by an experiment which he made. He mixed it with water, he weighed the quantity of water which came off in the shape of vapour at 212°; he took care to preserve it when distilled, and the water that came off was the same as the water of solution; 'and the moment he had done that the colour appeared.'"

Evidently, therefore, the judge considered that a strong aqueous solution of a salt must boil at 212°, which is a most decided blunder.

It is curious to observe how this error affects the whole case. Thus, when the preparation of arsenic acid came on for discussion, an evident corollary of this false science was, that in boiling down an aqueous solution of arsenic acid the evaporation must take place at 212°. Therefore, if you boiled down to physical dryness you must get the hydrate richest in water that is physically dry at 212°.

The fact is, that a strong aqueous solution of arsenic acid boils at something like 400° Fahr., and it is the acid physically dry at 400°, and not at 212°, that is the result of this boiling down to physical dryness.

It is unfortunate for the country that an important case like this Magenta case should be made to depend upon the dictum:—"Aqueous solutions must have the boiling point of pure water."

Charles Dickens was not very far off the mark when he described the "Circumlocution Office," with its art of "How not to do it." The Circumlocution Office has lately shown itself to be almost equally proficient in the art of not arriving at the truth. I am, &c. W.

MISCELLANEOUS.

The Powers of Gun-Cotton.—The *Quarterly Journal of Science* contains a paper, by Mr. Scott Russell, on "Gun-cotton;" in which he explains some of its properties, as follows:—"Ask gun-cotton to separate a rock already half-separated, it will refuse to comply with your request. Give it a light burden of earth and open rock to lift, it will fail. If you want it to do the work, you must invent a *ruse*,—you must make believe that the work is hard, and it will be done. Invent a difficulty and put it between the cotton and its too easy work, and it will do it. The device is amazingly successful. If the cotton have work to do that is light and easy, you provide it with a strong box, which is hard to burst—a box of iron, for example; choose a small charge, that would be harmless, in a little iron box, and then place that box in the hole where formerly the charge exploded harmless, and in the effort it makes to burst that box, the whole of the light work will disappear before it."

ANSWERS TO CORRESPONDENTS.

⁎ All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements* and *Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

At the time of going to press our Paris letter had not arrived.

W. B.—Deferred for the present.

X. will see the point discussed in a future lecture.

W. G. S. W.—The elements of the Maynooth battery are cast-iron and zinc. The outer cell is of cast-iron, containing strong nitric acid, and the amalgamated zinc is placed in a porous cell with diluted sulphuric acid. The arrangement is the same as in Grove's.

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[*] *Colour* appears from the context to be a clerical error for "the mixture," *i.e.*, the solution of arseniate of aniline in water.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Difference between Active and Ordinary Oxygen, by M. CLAUSIUS.

SOME years ago M. Clausius put forth an hypothesis on the nature of ordinary and active oxygen or ozone bearing resemblance to previous hypotheses proposed by other chemists (notably MM. Favre and Silbermann, Gerhardt, and Brodie), and which he expresses in the two following propositions :—

1. Ordinary oxygen is formed of atoms united in binary groups, active oxygen of isolated atoms.

2. The two atoms constituting a molecule of ordinary oxygen are in opposite electric conditions.

To these two fundamental hypotheses are added the two following accessory hypotheses :—

3. The two isolated atoms proceeding from the division of a molecule of ordinary oxygen immediately lose their positive or negative electricity and become neutral.

4. The atoms remaining isolated if a volume of ozone contains the same number of molecules as the same volume of some other simple gas, the density of the ozone should be half that of ordinary oxygen.

The third hypothesis is hardly compatible with the existence of antozone, nor with the well-known property of ozone of exercising two opposite actions on oxygen held in combination. M. Clausius, moreover, thinks it better to abandon it. He consequently admits that ozone is formed of electro-negative atoms, and antozone of electro-positive atoms, besides which he thinks it probable that the atoms of ozone constantly retain their electro-negative state, but that the facts as yet known do not authorise so precise a conclusion with regard to antozone.

As to the fourth hypothesis, it has become absolutely inadmissible, since the recent experiments of M. Babo and M. Soret have established the fact that ozonised oxygen increases in volume in passing to the state of ordinary oxygen. To reconcile this remarkable phenomenon with his fundamental hypothesis, M. Clausius now supposes that the isolated atoms of active oxygen are able to unite by reason of a feeble affinity between binary molecules of ordinary oxygen; the density of the gas is thus augmented without sensibly diminishing the chemical activity proper to the isolated negative or positive atoms.—*Annales de Chemie et de Physique*, i., 499, 1864.

Researches on Oxygen, by Dr. G. MEISSNER.

(Continued from page 49.)

THE very different behaviour of the two bodies formed from ordinary oxygen by electrisation affords an easy means of separating them. If we fill a large dry flask with strongly electrised air or oxygen, and then put in a little water and shake, a cloud is formed. When the water is poured out, and the well-closed flask is left to itself, the cloud gradually disappears; and when the air has become quite transparent it is easy to prove the presence of ozone.

Atmizone, like ozone, can also be suddenly destroyed. If the electrised air or oxygen be passed through a strongly-heated tube no cloud will be formed when the gas comes in contact with water. Andrews has shown that a temperature of 235° or 240° is sufficient to destroy ozone, and an equal temperature will effect the destruction of atmizone, whether moist or dry.

Atmizone, moist or dry, is also destroyed by contact with platinum-black or the binoxides of manganese and lead.

A slight increase of temperature seems to effect no change in atmizone; but in contact with nearly boiling water it is destroyed in two moments. We have seen that in contact with water atmizone changes more quickly than in the dry condition, and we now see that in contact with hot water the change is effected at a lower temperature than by the application of a dry heat.

We have hitherto studied the behaviour of atmizone after the removal of ozone; we shall now investigate its behaviour in the presence of ozone. When electrised air or oxygen is led directly into water a cloud appears if the air was dry until it entered the water, and it was, moreover, strongly electrised. But when ozone is present the mist is always much weaker than when the air stream is first deozonised and then saturated with moisture.

The following is the best way of showing the difference :—The tube in which the stream of air or oxygen is electrised is connected with a forked tube, one arm of which passes into iodide of potassium solution and then into water, while the other passes directly into water. Under these circumstances it will be seen that a mist is formed in each case, but is much stronger on the deozonised side. The question, Why the presence of ozone diminishes the mist forming power of the atmizone? admits of two possible answers. It may be that the deozonised air contains much less atmizone; or it may be that the amount of atmizone is not diminished, but that the ozone interferes with the attraction of atmizone for water. The author then proceeds to detail several experiments, which show, first, that when atmizone and ozone are together in the presence of aqueous vapour, the attraction of the atmizone for water is greatly diminished; and, secondly, that in the presence of ozone atmizone is much more quickly changed than when that body is absent.

We unfortunately possess no means of estimating atmizone quantitatively, but the author gives reasons for supposing that ozone and atmizone exist in the electrised air or oxygen in equivalent quantities. He also supposes that under most circumstances they disappear, or revert to common oxygen in equivalent quantities; but when a stream of electrised air containing a mixture of the two is examined in the manner just described, the atmizone changing more quickly than ozone, the latter soon predominates so much as to prevent the atmizone from forming a cloud.

In the dry state, as before remarked, ozone and atmizone change more slowly than when moist. This is also true of a mixture of the two; but it was noticed that in the dry state the change in the atmizone involved the change of more ozone than took place when the mixture was moist.

The next chapter of this interesting work details the experiments of the author to ascertain whether the body to which we have hitherto given the name of *atmizone* is identical with Schönbein's *antozone*. According to Schönbein the peculiar characteristic of antozone as distinguished from ozone is its power of converting water into peroxide of hydrogen HO_2, which ozone will no more effect than common oxygen. Meissner therefore first endeavoured to ascertain whether atmizone would oxidise water, and produce oxygenated water. As a preliminary step, and in order to make certain of having a delicate and safe test for the peroxide of hydrogen, the author repeated all Schönbein's experiments on the preparation and recognition of the peroxide.

As is well known, Schönbein first prepared free antozone from peroxide of barium. He noticed that when finely-powdered peroxide of barium was dropped into monohydrated sulphuric acid, the oxygen evolved had a peculiar smell like that of ozone, and possessed strongly oxidising properties, but still presented this essential difference to ozone, that at a low temperature it had a strong disposition to oxidise water to HO_2. This experiment Meissner confirmed. He took a wide glass tube something like a test-tube, and furnished with a ground-glass stopper, and supported within it a shorter and narrower tube. In the larger tube he placed water, and in the smaller pure sulphuric acid, and arranged that the surface of the water should not be far from the sulphuric acid. He now dropped small quantities of finely-powdered peroxide of barium into the sulphuric acid at short intervals, replacing the stopper after each addition. The author noticed that the oxygen evolved had a peculiar smell somewhat resembling that of ozone, but by an immediate comparison he found a remarkable difference; he noticed also on breathing the gas that it produced a choking sensation, an effect which ozone does not produce. The water he found absorbed this gas with avidity, and after some time he had a dilute solution of peroxide of hydrogen. During the experiment the temperature of the tube must be kept low, and it is convenient to change the sulphuric acid tube occasionally. Pure ozone, whether produced by electricity or by the slow combustion of phosphorus, Schönbein has proved never oxidises water. In this way, however, only a very dilute oxygenated water is produced, and the author next set about producing a much stronger solution.

(To be continued.)

British Pharmaceutical Conference. — The meetings for the present year will be held at 41, Milsom-street, Bath, and will commence on Wednesday, September 14. Papers to be read must be sent to the Secretaries fourteen days before the commencement of the meetings. The local secretary is Mr. J. C. Pooley, who will afford members all the information desidered.

Chloroform a Test for Sugar in Urine.—M. Cailliau states that when urine containing sugar is violently shaken with half its bulk of chloroform, the mixture becomes milky, and will separate into two layers. The upper is clear and almost colourless, while the lower is white, thick, and gelatinous. When the upper layer is removed, and left to evaporate in a porcelain dish, the liquid becomes syrupy as it evaporates, and after some days the sides of the dish become covered with the wart-like masses of sugar.—*Journal de Chemie Med.*, xi., 449.

Aniline in Varnishes.—When an alcoholic solution of aniline is evaporated upon a glass plate, there remains a thin transparent coating of aniline, which by reflected light appears as a metallic green iridescence, but by transmitted light of a blue or violet colour, according to the shade of aniline used. As aniline is soluble also in spirit varnishes, it is proposed to prepare such a blue transparent varnish for coating bottles, used for the preservation of substances easily affected by light.—*N. Jahrb. Ph.* xx. 44.

Soda in Coal Gas.—On examining the flame of the gas supplied in Munich, Professor Vogel remarked a pale soda line which was not observed when the gas was passed through sulphuric acid. On analysing afterwards the deposit on the surface of a copper burner which had been in use a year, the Professor found a considerable proportion of sulphate of soda.—*Neues Repert. für Pharm.*, xii., 8-75.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, *F.C.S.*

(Continued from vol. ix., page 244.)

7. **Discovery of Boyle's Law.**—About a year after the publication of Boyle's "Physico-Mechanical Experiments," Francis Linus published a treatise* in which he sought to prove the impossibility of the production of a vacuum, and the consequent fallacy of the results obtained by Boyle. The objections brought forward by Linus are, if possible, more absurd than those of Hobbes; they were very ably answered by Boyle,† and utterly unreasonable as was the theory on which they were based, we can but feel glad that it was propounded, inasmuch as in making experiments for its refutation, Boyle discovered the celebrated law of the compression of gases.

Linus admitted that the air possesses both weight and elasticity, but he denied that it is competent, in virtue of those properties, to produce the effects attributed to it by the vacuists.

One of the chief arguments adduced by Linus, against the explanation given by the vacuists of the Torricellian experiment, is the following:—If we take a tube less than 29½ inches long, say 20 inches, fill it with mercury, and then invert it in a vessel of mercury, the upper orifice of the tube being closed by the finger, the latter is found to be strongly pressed down; now, he reasons, if the air can support 29½ inches of mercury, and there are but 20 inches in the tube, the finger ought to be pressed upwards instead of downwards. To this Boyle answers very truly, that the finger has greater pressure on its upper surface than on its lower, because it has to bear the whole weight of the atmosphere on its upper surface, whereas below it has to bear the weight of the atmosphere—the weight of the column of mercury in the tube; hence, if there are 20 inches of mercury in the tube, the lower surface of the finger will be pressed upon by only one-third of the weight which presses upon its upper surface.

Again, argues Linus, if a tube 20 inches long is nearly filled with mercury, the upper orifice closed by the finger, and the lower opened beneath the surface of mercury, the mercury in the tube will descend somewhat, and the finger will be pressed strongly against the tube, if the air, then, cannot support 20 inches of mercury, how can it support 29½ inches? And if it be argued that the spring of the included air pushes down the mercury, it follows that the finger ought to be pushed upwards; but, answers Boyle, the upper part of the finger has to bear the whole weight of the atmosphere, whereas the air in the tube beneath the finger has the weight of the column of mercury to help it to overcome the weight of the atmosphere.

In order to account for the suspension of the mercury in the Torricellian experiment, Linus proposed his "Funicular hypothesis," which affirmed that the mercury remains suspended in the tube by a "funiculus" or cord of very thin matter, which is forcibly distended by the weight of the mercury, and perpetually endeavours to contract; when the mercury column has distended it to the extent to which such a weight is competent, the column rests suspended in the tube by the funiculus. Not only the Torricellian experiment, but all the effects affirmed by the vacuists to be due to the weight and elasticity of the air were attributed by Linus to the action of his funiculus.

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* "De Corporum Inseparabilitate, 1661."

† See "A Defence of the Doctrine touching the Weight and Spring of the Air, proposed by Mr. Boyle in his new Physico-mechanical experiments, against the objections of Franciscus Linus." By the Author of those experiments. London: 1662.

Boyle speaks of the theory as being "partly precarious, partly unintelligible, and partly insufficient, and besides needless;" it is curious, moreover, he remarks, that the funiculus should not only support a column of such a heavy liquid as mercury, but should also be able to draw in the sides of a glass vessel with sufficient force to break it; it is also remarkable that a pendulum should vibrate so readily in an exhausted receiver, if it has to cut through a number of stretched cords.

Pascal's Puy de Dôme ‡ experiment proved decisively the fallacy of all the theories of the Plenists; Linus was well aware of this, and he chose to doubt the accuracy of the experiment, because having tried it on the summit of a hill of but small elevation, it did not appear to succeed. Boyle replies that inasmuch as the Puy de Dôme experiment had been repeated five separate times, and had also been made in England with similar results, there can be no doubt of its accuracy. Mr. Richard Townley, a friend of Boyle's, modified the experiment by allowing a small quantity of air to remain in the tube above the mercury, and he found this enclosed air occupied a larger volume on the summit of a mountain than at its base.

In order to prove that the experiment obtains with small elevations, Boyle constructed a modified air thermometer, which would indicate very slight changes in the pressure of the air. This instrument consisted of a capacious glass bottle, into the neck of which a glass tube, open at both ends, was cemented; the tube reached nearly to the bottom of the vessel, and dipped beneath the surface of a small quantity of water placed therein, thus the air within the vessel had no communication with that outside; increase of pressure of the air would obviously cause the water to sink within the tube; whereas diminution of pressure would cause the air within the instrument to expand, and consequently to raise the water in the tube above the level of that in the vessel; it is needless to remark that such an instrument would only show difference of pressure in the air when the temperature was constant. The exact height at which the water stood on the ground was observed. Boyle then drew up the instrument by a rope to the leads of Westminster Abbey, a height of seventy-five feet from the ground: the water was found to have risen one inch in the tube, the temperature remaining constant.

We come now to the discovery of the important law which affirms that *the volume of a gas varies inversely as the pressure to which the gas is submitted*, and inasmuch as there is some dispute as to whether Boyle or the French philosopher Mariotte was the first to discover the law, we will consider the subject somewhat in detail.

In France and Germany the law is almost universally called "the law of Mariotte," in England generally "the law of Boyle and Mariotte;" sometimes "the law of Mariotte," seldom "the law of Boyle." I shall endeavour to prove that it is rightly the law of Boyle.

Roberval § enclosed a partially inflated carp's bladder in the Torricellian vacuum, and observed that it became fully inflated. Boyle made the same experiment with a lamb's bladder in the vacuum produced by his air-pump; on exhaustion, the bladder became fully inflated, and on the re-admission of air contracted to its former dimensions; he next inclosed air in a tube and measured its expansion on the removal of pressure; it was found to expand more and more with every stroke of the pump, until eventually it occupied 152 times its original bulk, to which latter it returned on the re-admission of air. Here, then, was the important fact that the greater the amount of pressure removed from air the more does it expand.

In order to see if the pressure of the air is the sole cause of the suspension of the mercury in the Torricellian experiment, Boyle (in the 17th of the Physico-mechanical experiments ‖) filled a tube three feet long with mercury and inverted it in a vessel of mercury, which latter he placed in the air-pump receiver, the tube being passed air-tight through its cover; on exhausting, the mercury fell lower and lower with every stroke of the pump, till it was almost on a level with the mercury in the vessel in which the lower end of the tube was placed; on admitting air into the receiver, the mercury rose above twenty-nine inches, on letting out the air it sank again to that height. It was thus indisputably proved that the height of the mercury is greater or less according as the density of the air pressing upon it is greater or less.

As the capacity of the receiver and of the air-pump cylinder could be readily determined, and thus the fall of the mercury in the tube due to the removal of a known amount of air, Boyle hoped to be "enabled to give a near guess at the proportion of force betwixt the pressure of the air (according to its various states, as to density and rarefaction) and the gravity of quicksilver," but on account of several difficulties which he mentions, and of the little leisure at his disposal, he says he shall content himself with having suggested the experiment.

We see, therefore, that prior to 1660 Boyle suggested a method for determining the relation of the density of air to the weight which it supports. After making the experiments given above, the discovery of Boyle's law was inevitable; no thinking man could make those experiments without inquiring whether the removal of a definite amount of pressure caused a definite expansion of the released air.

Let us now pass on to the actual discovery of the law. The fifth chapter of the second part of Boyle's "Defence against Linus" is entitled "Two new experiments touching the measure of the force of the spring of air compressed and dilated."

Linus, as before mentioned, had throughout his treatise affirmed that the elasticity of the air is incompetent to produce the effects attributed to it by the vacuists; the experiments detailed in this chapter were made by Boyle in order to prove that the spring of the air is able to effect not only as much but far more than the vacuists attribute to it.

To prove this Boyle procured a long glass tube, and bent it in the form of a syphon with parallel limbs, each of which was divided into inches and eighths; one limb was considerably shorter than the other, and its orifice was hermetically sealed, ¶ (in fact, the instrument was exactly similar to that which we use in the present day for illustrating Boyle's law). Mercury was poured into the instrument until it stood level in each limb at the commencement of the scale, mercury was then poured into the longer limb until the air in the shorter was reduced to half its original bulk, "when," he writes, "we cast our eyes upon the longer leg of the glass, on which we likewise pasted a list of paper carefully divided into inches and parts, and we observed, not without delight and satisfaction, that the quicksilver in that longer part of the tube was twenty-nine inches higher than the other." . . . "We were hindered," he continues, "from prosecuting the tryal at that time by the casual breaking of the tube. But because an accurate experiment of this nature would be of great importance to the doctrine of the spring of the air, *and has not yet been made (that I know) by any man*, ... we at last procured a tube of the figure exprest in the scheme." This tube was exactly similar in form to the other, but larger in its dimensions; from experiments made with it, Boyle deduced the following table, which he calls

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‡ For an account of this experiment see the third of these papers. Chemical News, vol. viii., p. 247.

§ This experiment is first mentioned in a work which was published by the Accademia del Cimento, and which contains an account of the experiments made by its members. Of this important scientific society we shall have to speak hereafter.

‖ This and the previous experiment have been before mentioned in the fourth and fifth of these papers. They are introduced here because they bear upon the discovery of Boyle's law.

¶ Boyle had previously (in the 36th of the Physico-mechanical experiments) made use of a similarly shaped tube open at both ends for determining the relative weights of water and mercury. Mercury was poured into the tube till it stood level in each limb at the commencement of the scale; water was then poured into the longer limb, and it was found that $30\frac{44}{64}$ inches of water balanced $2\frac{21}{64}$ inches of mercury, making the relative weights of mercury and water as 1 to $13\frac{22}{121}$.

"*A Table of the Condensation of the Air.*"

A Space occupied by the air in the shorter limb of the instrument in inches.	*B* Height of the column of mercury in the longer limb, the weight of which column caused the change of volume shown in *A*.	*C* Pressure sustained by the air in the shorter limb, expressed by the height of the column of mercury in the longer limb + 29⅛ inches, the height of the column of mercury supported by the atmosphere.	*D* Theoretical pressure sustained by the air in the shorter limb, if we suppose "the pressures and expansions to be in reciprocal proportions."
12	00	$29\frac{2}{16}$	$29\frac{2}{16}$
$11\frac{1}{2}$	$01\frac{7}{16}$	$30\frac{9}{16}$	$30\frac{6}{16}$
11	$02\frac{13}{16}$	$31\frac{15}{16}$	$31\frac{12}{16}$
$10\frac{1}{2}$	$04\frac{6}{16}$	$33\frac{8}{16}$	$33\frac{1}{7}$
10	$06\frac{3}{16}$	$35\frac{5}{16}$	35
$9\frac{1}{2}$	$07\frac{14}{16}$	37	$36\frac{15}{19}$
9	$10\frac{2}{16}$	$39\frac{4}{16}$	$38\frac{7}{8}$
$8\frac{1}{2}$	$12\frac{8}{16}$	$41\frac{10}{16}$	$41\frac{2}{17}$
8	$15\frac{1}{16}$	$44\frac{3}{16}$	$43\frac{11}{16}$
$7\frac{1}{2}$	$17\frac{15}{16}$	$47\frac{1}{16}$	$46\frac{3}{5}$
7	$21\frac{2}{16}$	$50\frac{5}{16}$	50
$6\frac{1}{2}$	$25\frac{3}{16}$	$54\frac{5}{16}$	$53\frac{10}{13}$
6	$29\frac{11}{16}$	$58\frac{13}{16}$	$58\frac{2}{8}$
$5\frac{3}{4}$	$32\frac{3}{16}$	$61\frac{5}{16}$	$60\frac{18}{23}$
$5\frac{1}{2}$	$34\frac{15}{16}$	$64\frac{1}{16}$	$63\frac{6}{11}$
$5\frac{1}{4}$	$37\frac{15}{16}$	$67\frac{1}{16}$	$66\frac{4}{7}$
5	$41\frac{9}{16}$	$70\frac{11}{16}$	70
$4\frac{3}{4}$	45	$74\frac{2}{16}$	$73\frac{11}{19}$
$4\frac{1}{2}$	$48\frac{12}{16}$	$77\frac{14}{16}$	$77\frac{2}{3}$
$4\frac{1}{4}$	$53\frac{11}{16}$	$82\frac{12}{16}$	$82\frac{4}{17}$
4	$58\frac{2}{16}$	$87\frac{14}{16}$	$87\frac{3}{8}$
$3\frac{3}{4}$	$63\frac{15}{16}$	$93\frac{1}{16}$	$93\frac{1}{5}$
$3\frac{1}{2}$	$71\frac{5}{16}$	$100\frac{7}{16}$	$99\frac{6}{7}$
$3\frac{1}{4}$	$78\frac{11}{16}$	$107\frac{13}{16}$	$107\frac{7}{13}$
3	$88\frac{7}{16}$	$117\frac{9}{16}$	$116\frac{4}{8}$

Boyle next made some experiments on the expansion of air under diminished pressure. He was informed, however, by the afore-mentioned Mr. Townley, that he (Mr. Townley), since reading the "Physico-Mechanical Experiments," had endeavoured—acting, I suppose, on the suggestion given by Boyle in the seventeenth experiment mentioned above—to determine the amount of expansion of a certain quantity of air on the removal of known amounts of pressure. Townley had commenced a paper on the subject, which he showed to Boyle, but it was apparently never published.[**] Boyle does not mention whether he employed the same method as that adopted by Townley.

Boyle's method was the following:—A long tube, one end of which was open and the other hermetically sealed, was divided into inches and eighths; it was filled with mercury and placed in a vessel of mercury of the same depth as itself. One inch of air was then passed into the upper part of the tube, the mercury within and without being brought to the same level. The tube was now raised till the air within it had expanded to double its volume, and the pressure acting upon it determined by subtracting the height of the column of mercury below the air from 29¾ inches, which at the time of making the experiment was the height of the column of mercury supported by the atmosphere. The arrangement of the apparatus was exactly the same as that figured in our present works on physics. Boyle gives a table of the results which he obtained, which he calls "A Table of the Rarefaction of the Air."

Let us now consider the claims of Mariotte.

Fourteen years[††] after Boyle published the above experiments, Mariotte's "Essai sur la Nature de l'Air," first made its appearance. In this essay[‡‡] Mariotte informs the reader that the first great property of air is that it possesses weight, the second that it is capable of condensation and expansion; he then passes at once to the question whether the air is condensed in exact proportion to the weight which acts upon it. In order to ascertain this, Mariotte, together with a M. Hubin, procured a glass tube 40 inches long, sealed one end of it hermetically, and poured in mercury until it stood at 27½ inches from the end of the tube, the open end was then closed by the finger, the tube inverted, and opened beneath the surface of mercury; the mercury in the tube fell till it rested 14 inches above that in the vessel, and the air occupied 25 inches; 24 inches of mercury were next placed in the tube, on inverting the mercury fell to 7 inches, and the air occupied 32 inches; by these and other experiments, made with different quantities of mercury in the same tube, similar results were obtained. We may, therefore, writes Mariotte, take it "pour une régle certaine, ou loi de la nature, que l'air se condense à proportion des poids dont il est chargé."

The truth of this law, he continues, may be more strikingly proved by taking an inverted syphon tube, one limb of which is 8 feet long and the other 1 foot, &c. He here proceeds to describe the construction and manner of using the instrument we have before mentioned as being that by the aid of which Boyle discovered the law.

It appears almost inconceivable that in sixteen years Mariotte should not have read the "Physico-Mechanical Experiments," in which we have seen Boyle so clearly suggested experiments on the subject in question, and it appears almost as inconceivable that in fourteen years[§§]

[**] There are several papers by Townley in the early numbers of the *Philosophical Transactions*, but not one of them relates to the subject in question; neither do I find mention of any paper by Townley on the subject, in Watt's "Bibliotheca Britannica."

[††] The author of the article on Mariotte in the "Biographie Universelle" (1820) writes:—"Son discours sur l'air, qui parut en 1679 renferme une suite d'expériences intéressantes, alors absolument neuves." The "Nouvelle Biographie Générale" (1860), on the other hand, states that the essay appeared in 1676. In the preface to Mariotte's collected works it is stated that the essays "On Plants," "On the Air," and "On Heat and Cold," appeared between 1676 and 1679. In the text I have given Mariotte the benefit of the earlier date.

[‡‡] See "Oeuvres de M. Mariotte de la Academie Royale des Sciences." Paris, 1740.

[§§] It will be remembered that the "Physico-Mechanical Experiments" appeared in 1660, and the "Defence against Linus" in 1662.

he should not have read the "Defence against Linus," containing not only the discovery of the law, but more elaborate experiments than he gives to illustrate and prove it. I find, however, no mention of Boyle's experiments in Mariotte's essay, at the same time he appears to be relating known facts rather than perfectly new and original experiments: it is curious, moreover, if he knew nothing of Boyle's experiments, that he should have used the same instrument, and directed it to be made of the same dimensions as those recommended by Boyle.

But allowing that Mariotte discovered the law independently of Boyle, is priority of discovery nothing? Do we not know that it is everything in the present day? And if now why not 200 years ago? Suppose a man were to discover a metal possessing, as he believed, properties different from those of any known metal, that he published an account of it, and that it proved to be cæsium, should we, in speaking of the discovery of the latter, couple his name with Bunsen's? Most assuredly not, however laboriously he had worked, however elaborately his research had been carried out. It is the duty of every man, before commencing a research, to find out how much has been done by other experimenters; if this were done more completely, what a large amount of controversial matter would be excluded from scientific literature.

It is true that 200 years ago there were less opportunities of ascertaining the results obtained by other experimenters than in the present day; there was so little physical science in the world, Nature had for so short a time been interrogated by experiments, that many philosophers had a habit of believing everything they discovered was new, and did not trouble themselves to ascertain the results obtained by others, but surely in fourteen years Mariotte might have made himself thoroughly acquainted with all the important discoveries which had been made relative to the air.

I trust, on consideration of the above facts, it will be conceded that the law which affirms that the volume of a gas varies inversely as the pressure to which the gas is submitted, is not "the law of Mariotte," but "the law of Boyle."

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

Method of Determining the Amount of Alkaloids in Cinchona Bark, by Dr. J. E. DE VRY.

THE author has adopted the following process as one yielding the different alkaloids as they are contained in the bark, without alteration from the chemicals used for their extraction:—

The powder of the bark is dried at 212° Fahr., and the weight ascertained in the dry state. If possible, it is always preferable to use the same quantity. It is now mixed with a quarter of its weight of slaked lime, and this mixture boiled with ten times its weight of spirit of sp. gr. 0·85 during five minutes. The whole is now put into a filter, and exhausted by successive quantities of boiling spirit, making the whole quantity of spirit used equal to twenty times the weight of the bark. The alcoholic solution, after having been acidulated by dilute acetic acid, is evaporated on a water-bath till the alcohol has been expelled. The residue of the evaporation is now repeatedly treated with water till the filtered liquid is no longer rendered turbid by an alkali. The watery solution thus obtained contains all the alkaloids, whilst the quinovic acid, fatty and resinous matter, &c., remain upon the filter. If this filter, with its contents, be treated with milk of lime, the quinovic acid can be determined. The watery solution of the alkaloids is next brought to a small volume by evaporation on a water-bath, and then mixed with an excess of slaked lime, by which the alkaloids are precipitated. The whole is now thrown upon the smallest possible filter and washed with a minimum quantity of cold water. If properly managed, the quantity of water necessary to remove the colouring matter is so small, that the loss of alkaloids by their little solubility in lime-water can be neglected; and if in a series of investigations care is but taken to work under the same conditions, as to size of the filters, &c., &c., the small loss before mentioned has not the least influence on the comparability of the results. After the filter has been properly washed it is dried and boiled repeatedly with alcohol of 0·82, till the alcohol dissolves nothing more. After filtration the slightly-coloured alcoholic solution is evaporated in a small weighed platinum vessel, and the residue heated on the water-bath until its weight ceases to diminish. The amount of the alkaloids in the bark is now known, and to ascertain the quality of the different alkaloids, they are dissolved in the smallest possible quantity of very dilute acetic acid. Sometimes there remains a trace of resinous matter undissolved, but in the majority of cases this trace need not be noticed. If, however, in an exceptional case the resinous matter is in such quantity that it can be weighed, its weight must be ascertained and subtracted from the amount of alkaloids. The acetic solution of the alkaloids is now placed in a closed funnel, provided with a cock, and agitated with a slight excess of caustic soda and a quantity of ether equal to fifteen times the weight of the alkaloids. After this agitation, the whole must stand at least six hours; for, although cinchonidine and quinidine are sparingly soluble in ether, a large amount of them is dissolved upon the first agitation, but is separated in crystals after a few hours. The ethereal solution is now evaporated, and the residue heated on a water-bath till its weight remains constant. This residue is quinine, containing traces of cinchonidine, quinidine, or cinchonine, and in many cases a large amount of the still unknown fusible alkaloid. By the known reactions of chlorine and ammonia, and by the preparation of *Herapathite*, the real nature of this residue can be ascertained. The alkaloids which have not been dissolved by the ether are now again dissolved in the smallest possible quantity of dilute acetic acid, and this solution mixed with a few drops of a concentrated solution of iodide of potassium. After stirring the liquid with a glass rod, there will appear a sandy crystalline precipitate if quinidine is present. In such case, the hydriodate of quinidine is collected upon a filter, dried at 212° Fahr., and its weight ascertained, whilst the amount of pure quinidine can be ascertained by calculation from the known weight of the hydriodate: 100 parts of hydriodate are equivalent to 71·68 parts of quinidine, according to the formula $C_{40}H_{24}N_2O_4, HI$. The liquid separated by a filter from the hydriodate is precipitated by caustic soda, and the precipitate noted as cinchonine, or as a mixture of cinchonine and cinchonidine, which depends upon special observations. If the solution of iodide of potassium produces no precipitate, the solution is precipitated by caustic soda, and the precipitate may be regarded as cinchonine, or as a mixture of cinchonine and cinchonidine. The presence of cinchonidine or quinidine among the alkaloids of a bark can be easily conjectured at the time of their treatment with ether; for if one of these alkaloids is present, it is partially deposited in a crystalline state after some time. Whilst the quinidine can easily be ascertained by iodide of potassium, even in small quantities, the presence of small quantities of cinchonidine can only be ascertained with certainty by the polarising apparatus, by which instrument I have, for instance, found the cinchonidine of Pasteur in the bark of *C. pahudiana*, of Java.—*Pharm. Journal.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture XII. (*Last of the Course*).—*Saturday, January* 30.

(Continued from page 69.)

Sulphuretted hydrogen is found in some of the exhalations. Vapour issues from the Solfataras of Krisuvik in Iceland with sufficient force to project stones of the size of the hand to the height of several feet. Bunsen found this vapour to consist of 82·3 of steam and 17·2 of gas. You see how large a proportion of water is always given out. The 17·2 per cent. of permanent gas consisted of—

Carbonic acid	87·43
Sulphuretted hydrogen . .	6·60
Free hydrogen	4·30
Nitrogen	1·67
	100·00

The composition of the gas was somewhat different at the point of issue, containing a smaller proportion of aqueous vapour and more carbonic acid. It is approximately estimated that this gaseous spring alone yielded during twenty-four hours 223 cubic metres of sulphuretted hydrogen (which is an enormous amount), 12 cubic metres of pure hydrogen, and a quantity of steam, the total effect of which would be equal to the power of thirty horses. Close to this spring was another nearly as large, which yielded gas of almost identical composition; and in a valley in the proximity numerous large pools of boiling mud, between which, we are informed, vapour breaks out with remarkable violence. Bunsen tells us that, although the small space of solid ground then surrounding it was continually covered with hot clouds of vapour, it was possible to penetrate to the openings from which the vapour issued by means of the crusts of gypsum which had been formed between the boiling pools, and to collect the gas for analysis. Note the fact of the formation of gypsum under these circumstances. He found the gas to consist mainly of carbonic acid and sulphuretted hydrogen. Here is the analysis of it:—

Carbonic acid	79·07
Sulphuretted hydrogen . .	15·71
Hydrogen	4·72
Nitrogen	0·50
	100·00

The sulphuretted hydrogen seems to play an important part in the metamorphism of the adjacent rocks. As the resulting products have an acid reaction, owing to the oxidation of the sulphuretted hydrogen and the formation of sulphuric acid, they can contain neither carbonate of lime nor silica, and accordingly those bodies are never found in them. The acid would, of course, dissolve out the carbonate of lime, and, as there is no acid there to decompose the silicates formed, there would be no separation of silica. That is obvious enough. The sulphuric acid proceeds from the oxidation of the sulphuretted hydrogen, which, therefore, rapidly decreases, while the carbonic acid does not. In illustration, I may cite the composition of gas taken from different small pools of the Solfatara of Krisuric:—

Nitrogen	1·80
Carbonic acid	88·54
Sulphuretted hydrogen . .	1·79
Hydrogen	7·87
	100·00

Notice how large the proportion of carbonic acid is. The sulphuretted hydrogen, of which we had a large quantity in the former case, has been gradually removed by oxidation, forming sulphates, and so on, and reduced to 1·79. Then there is a gas in the "Acqua bollente," in Vulcano, one of the Lipari Islands, which has been examined by Deville, and found to contain an enormous proportion of sulphuretted hydrogen, larger than in any analysis I have yet seen recorded, namely, 82·8 per cent., with 9·8 of carbonic acid, and 6·8 of nitrogen.

Sulphur is another substance occurring in the exhalations of volcanoes. Volcanic eruptions are nearly always attended with the sublimation of sulphur, not only with the evolution of sulphurous gases, but with the actual sublimation of solid sulphur Let us examine this point closely. According to Bunsen, deep down in the earth are masses of sulphur, of which, he says, "the occurrence may be easily accounted for by the action of volcanic heat upon decomposable sulphur compounds." It is to be regretted that this distinguished philosopher should not have specified those sulphur compounds which are reported to be thus capable of evolving sulphur when heated alone. There is one with which we are all well acquainted, which does evolve sulphur, namely, bisulphide of iron; but I am not aware that there are any other sulphur compounds which are likely to occur, or that there is any mass which will be decomposed by heat alone with the evolution of sulphur. The generation of sulphuretted hydrogen may be explained by supposing the contact of the vapour of water with metallic sulphides, when the metal would be oxidised, and the sulphur liberated in combination with hydrogen—a common experiment to make sulphuretted hydrogen. We pass the vapour of water, a compound of oxygen and hydrogen, over a metallic sulphide. The metal is thus oxidised, and sulphuretted hydrogen is formed, the sulphur of the metallic sulphide combining with the hydrogen of the water. Conversely, if sulphuretted hydrogen comes in contact with oxide of iron or other metallic oxides, either free, or combined as in basalt and silica, we get sulphurous acid and protosulphide of iron. You know that if the vapour of water is passed over metallic iron the iron is oxidised, and hydrogen is liberated. Conversely, when you pass hydrogen over a metallic oxide, that oxide is reduced to the metallic state. These reactions appear to be exceedingly probable, to say the least. That sulphur is evolved abundantly from volcanoes we know; and if it does not exist in a free state, it must, of course, be a product of decomposition. And, I ask, what is so likely to undergo that decomposition as protosulphide of iron arising from the action of steam at high temperatures? We know that steam is there, and sulphur must be there, and we know also that there is a temperature adequate to produce the result. Again, sulphurous acid and sulphuretted hydrogen, in contact, mutually decompose each other, with a formation of water and the deposition of sulphur; and there is no doubt that the free sulphur in many volcanic products, or in certain volcanic products, has been produced in this way—for instance, the free sulphur to which Bunsen has particularly drawn our attention in those pools of boiling mud. Admitting, for the sake of argument, the presence of accumulations or masses of sulphur, such as Bunsen refers to, the phenomena which are supposed consecutively to take place are—first, the contact of sulphur with red-hot pyroxenic rock, the iron of which becomes first converted into magnetic oxide, with the evolution of an equivalent proportion of sulphurous acid; sulphide of iron is next generated; then follows the decomposition of that sulphide of iron by the action of steam at a high temperature. The metal is oxidised, and the sulphur liberated as sulphuretted hydrogen, which is resolved, in a greater or less degree, into hydrogen and sulphur, and hence occurs, as Bunsen observes, "the irregular, simultaneous exhalation of these gases, namely, sulphurous acid and sulphuretted hydrogen, at spots but little distant from each other in the same fumerole district. The sulphurous acid, whose appearance alone characterises the initial stage of all these phenomena, is accompanied for a while by sulphuretted hydrogen, which, by its reaction with the former gas, gives rise to that succession of decompositions which characterise the true solfataras. Acid liquors saturate the rocks traversed by separated sulphur, and torn up by aqueous vapour, converting these rocks, whether they belong to the pyroxenic or trachytic group, into clay, by extracting from the silicates entering into their composition, potash, soda, magnesia, lime, and protoxide of iron, and frequently a part of the alumina, as sulphates." The silicate of alumina is in the well-known plastic state of common clay. This is, no doubt, one way in which clay has been formed on a large scale. In the course of time this destructive action on the rocks is succeeded by a productive one, which increases in proportion as the source of sulphurous acid becomes extinct, and the gradually decreasing evolution of sulphuretted hydrogen recedes to greater depth. The acid reaction of the water is then succeeded by an alkaline one due to the formation of alkaline sulphides. Carbonic acid now acts upon the rocks, alkaline bicarbonates are formed, and silica is dissolved, which may be ultimately thrown down, as we have seen, in the form of Geyser structures. The appearance of springs of carbonic acid is the last stage of this series of metamorphic phenomena. The first effect of acid fumerole gases is the bleaching of the rock, due to the dissolving out of the oxide of iron. The rock becomes gradually disintegrated, until at length there remains nothing but a plastic argillaceous mass comparatively free from iron. The collateral products are crystals of iron pyrites, hyalite, hydrated oxide of iron, and anhydrous red oxide of iron. Some difficulty may occur to you in explaining how this anhydrous red oxide should be generated. Bunsen asserts—and I believe he is right—that it is formed by the long-continued action of boiling in these ferruginous mud pools. Occasionally we find gypsum, of which I have spoken several times, and carbonate of lime produced under these conditions.

Bunsen explains especially—and this, I think, is one of the most interesting parts of his papers—how gases penetrating a rock along with aqueous vapour may completely metamorphose the substance of that rock on the spot, without any removal of the products of decomposition; and he illustrates his explanation by examples, and supports it by chemical analyses. To this kind of action he applies the very appropriate term "pneumatolytic." He maintains that even a zeolitic amygdaloid, full of cavities containing zeolites, which occurs abundantly in Iceland, is only a variety of trap metamorphosed on the spot, without the removal or deposition of any further matter. He advances, in support of this view, the fact that one passes by insensible gradations into the other, and that the average composition of the amygdaloid rock —abstraction being made of the water it contains—is identical with that of the trap. However this may be, I may mention that from other experiments or other statements he has made, we have indisputable evidence that all zeolites are not so produced. Bunsen makes a very sweeping statement with regard to zeolitic formations, which I think by no means justified, and which is in opposition to facts which have come to light since his statement was made.

Nitrogen is a constituent of volcanic gas, but its proportion varies much. Bunsen found 81·81 per cent. in the gas from a fumerole in the great crater of Etna.

Free oxygen occurs only as an occasional constituent in the published analyses of volcanic gases. Along with the 81·81 per cent. of nitrogen in the gas from the great crater of Etna Bunsen found 14·21 per cent. of free oxygen. In the gas of non-acid fumeroles Deville found the proportion of oxygen relatively to the nitrogen to be 20·8, and in the acid fumeroles 19·7. This shows that in the acid fumeroles a little oxygen had been abstracted, for the proportion was sensibly less than that existing in the other case. This was easily accounted for by the generation of sulphuretted hydrogen and the evolution of oxygen in consequence.

Ammonia is often evolved, but in combination with hydrochloric acid, and condenses in the solid form of sal-ammoniac. Mineralogical cabinets often contain specimens of this. Some months after the eruption in 1846, Bunsen tells us he observed the lower part of the lava stream studded over with smoking fumeroles, "in which (he says) so large a quantity of beautiful crystallised muriate of ammonia was undergoing a process of sublimation that, notwithstanding the incessant torrents of rain, hundreds of pounds of this valuable salt might have been collected." Its production was limited to the zone in which meadow land had been overflowed with lava; and higher up the muriate of ammonia and the last traces of vegetation ceased together. Hence, he infers that the ammonia is derived entirely from the organic matter of the soil. Ammonia is a constituent of the vapours evolved from the suffioni of Tuscany, and Liebig believed that it was not of organic origin, but was an original constituent of the earth's crust, on the ground that the temperature of the vapour was so high that it must have come from depths where "neither man nor animals could ever have lived." It was, however, urged in reply to that, that the hot vapour must have traversed sedimentary rocks above, in which, no doubt, organic residue was contained, and, therefore, Liebig's theory falls to the ground.

It is still a disputed point whether flame ever accompanies volcanic eruptions; but if hydrogen be evolved, which there is no ground for disputing, there is no reason, considering the high temperature, why flame should not be produced. The flame of hydrogen is very feebly luminous, and might possibly not be easily recognised in the bright glare of molten lava.

I have now passed in review some of the more important chemical phenomena connected with volcanic action, and you will naturally ask, to what conclusion do they lead concerning the causes of this action?

The amount of heat required to fuse such enormous masses of lava—veritable mountains of lava—as have been known to be ejected in a single eruption, is very great. I speak now of the *amount* of heat,—of the amount merely. The temperature, however, or, in other words, the *intensity* of the heat, need not be extremely high, as we can, without difficulty, melt various kinds of lavas or basalts in our ordinary furnaces. The question as to what is the source of this heat is one of intense interest. That is the main point for inquiry. Setting aside the hypothesis of central fusion, resulting from oxidation or other causes, is there reason for supposing subterranean chemical reactions, such as Davy suggested? This philosopher, it will be remembered, imagined that the alkaline and earthy metallic bases might be present deep below the surface of the earth, in a free state; but this would involve the evolution of an enormous quantity of hydrogen, but there is no proof, so far as I know, of evolution to anything like that extent. After a careful review of all the phenomena of volcanic action with which I am acquainted, I must say that I have failed to discover satisfactory evidence to justify belief in the chemical hypothesis.

With these remarks, ladies and gentlemen, I take my leave of you for the present.

LECTURES ON CHEMICAL PHILOSOPHY.—III.

Delivered at the College of France, by M. A. WURTZ.

(Continued from page 70.)

In conformity with the law first enunciated by Ampère we have laid down the two following principles :—

1. That equal volumes of a gas or simple vapour contain the same number of atoms.

2. That equal volumes of compound gases and vapours contain the same number of molecules.

It follows that the atom answers to 1 volume, and the molecule answers to 2 volumes; and that if we bring the densities into relation with that of hydrogen taken as unity, the atomic weights (or 1 volume) are given by the densities, and the molecular weights (or 2 volumes) are given by the double densities.

Let us establish by some examples the help which these laws relative to densities give us in fixing the atomic weights.

Let us take, for instance, carbonic acid CO_2. Its density (see page 70) = 1.529. If we multiply 1·529 by 28·88 (see page 70) we shall have 44, which is the weight of 2 volumes of carbonic acid; hence 44 is the molecular weight of carbonic acid. But the most simple view we can take of the composition of carbonic acid obliges us to admit that 2 atoms of oxygen are combined in it with 1 atom of (vapour volume) carbon. The two atoms (volumes) of oxygen weighing 32, the atom of carbon should weigh 12; 44 in fact represents 32 + 12, and 44 is exactly the sum of 2 atoms of oxygen and 1 atom of carbon.

Experiment has demonstrated, and Gerhardt has proved, that in all reactions the weight of carbonic formed is never less than 44; 44 then is the smallest quantity of carbonic acid which can exist free or be withdrawn from a compound. It is, therefore, the weight of the carbonic acid molecule.

In the same way, we find that the molecular weight of water is 18, and not 9. Its atomic formula is, therefore, $H_2O = 18$. Gerhardt, in fact, has also shown that the smallest amount of water which can be generated in any reaction is represented by 18 if 1 atom or 1 volume of H weighs 1.

Among the metals let us take mercury as the example, and see how we derive its atomic weight from the molecular weight of mercuric chloride, as it is given by the density of the vapour of the chloride. This density = 9·8. If we multiply by the double co-efficient 28·88 we have 283, which represents the molecular weight of the vapour of the chloride: 283 represents the atomic weights of the elements of the molecule. But the most simple hypothesis we can form is to consider the molecule of corrosive sublimate as containing 1 atom of mercury. According to the law of Dulong and Petit, the atomic weight of mercury is equal to 200, and this number is confirmed by the density of the vapour of sublimate. In fact, 283 of sublimate contain 200 of mercury; the remainder represents the weight of 2 atoms of chlorine. The molecular formula of corrosive sublimate is, therefore, HCl_2, in which H represents 200 of mercury.

We must now examine the exceptions to the laws of Dulong and Petit, and of Ampère, alluded to in the last lecture.

As regards the first, we have said that carbon, boron, and silicium are in complete disaccordance with the law—that is to say, when we multiply the atomic weights of these bodies by their specific heats we do not obtain a constant product.

We might dispose of this anomaly at once by remarking that these bodies may have several different atomic weights. This proposition may seem strange at first sight, but there are some chemical facts which may lead us to suppose it correct.

Sir B. Brodie, by means of a mixture of sulphuric acid, chlorate of potash, and graphite, has succeeded in forming a solid, yellow, highly carbonated acid, containing, according to his opinion, carbon in the form of graphite. Analysis leads him to consider 33 the atomic weight of the carbon in this compound. He has formulated this graphitic acid $Gr_4H_4O_5$. Besides this, the number 33 is deduced from the specific heat of graphite.

Carbon, which exists in several different allotropic states, seems, then, to be constituted of several distinct atomic aggregations. Boron and silicium appear to offer an analogous heterogeneity. Perhaps the secret of the exceptions to the law of Dulong and Petit may be found in this fact.

Among the simple bodies there exist four exceptions to the law of Ampère. These are phosphorus and arsenic on the one part, and cadmium and mercury on the other. The vapour densities of the first two are twice too high, and those of the two others are twice too low.

Until recently there was another anomaly. The vapour density of sulphur taken at 500° was three times too high. It was 6·6, which corresponds to 3 atoms S_3. But MM. Bineau and H. Deville have found that at 1000° it becomes 2·2—a number in perfect accordance with the law of Ampère.

It is possible that the vapours of phosphorus and arsenic may also split up or become loosened at very high temperatures. We have not yet succeeded in effecting this *loosening*, and it is possible that it can only be produced at temperatures much higher than we can reach.

The vapour densities of mercury and cadmium are twice too low. We may interpret this fact by comparing these metals with certain organic radicals which offer a similar peculiarity. We shall presently return to these considerations.

It is only, however, the atomic weights derived from the vapour density of phosphorus and arsenic which are double those which chemical processes assign to them. They express in reality the molecular weights of these two bodies.

The chemical atomic weights of mercury and cadmium are identical with the molecular weights deduced from the vapour densities. In other words, the atoms of gases and vapours correspond to 1 volume, while those of phosphorus and arsenic correspond to ½ a volume, and those of mercury and cadmium to 2 volumes.

We pass on to the exceptions which the vapour densities of compound bodies present. The vapour densities of sal ammoniac, perchloride of phosphorus, and sulphate of hydrogen,* and some other bodies are twice too little. The molecules of these bodies, instead of representing 2 volumes, represent 4 volumes.

Gentlemen, when we find ourselves face to face with a great fact—a fact which appears universal in its application,—with a great law, in a word,—if exceptions appear, it is not necessary to give up the law, but we must endeavour to confirm the law by the exceptions. We must interpret the fact in a sense favourable to the law.

Well, as regards the exceptional compounds with which we are now concerned, MM. H. Kopp, Cannizzaro, and Kekulé have thought that at the temperature at which we take the vapour densities of these bodies, their molecules no longer subsist, but are split asunder,—the perchloride of phosphorus, for example, into chlorine and protochloride, and sal-ammoniac into hydrochloric acid and ammonia. This decomposition is not permanent, but, as the temperature becomes low, the original compound is reconstituted, so that no trace of the *dissociation* remains.

The explanation is ingenious; but how can we demonstrate the truth of it? A chemical process designed to prove the existence of a mixture by causing the absorption of one of the mixed gases is inapplicable, seeing that a new body introduced into the gaseous mixture may act on the mixture by its affinities, and so set up a disturbing influence. We must then have recourse to physical proofs, and among these *diffusion* seems to be most appropriate.

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* We translate literally, but it may be necessary to inform some readers that the lecturer means sulphuric acid.

Diffusion has been tried. M. Pebal has diffused the vapour of sal-ammoniac (at 350°) in a tube full of hydrogen, and he has found that after the diffusion the lower part of the tube contained hydrochloric acid. There was then a mixture.

MM. Wanklyn and Robinson have diffused the vapour of sulphate of hydrogen and perchloride of phosphorus, and they have observed that at a high temperature decomposition took place, and there was, consequently, a mixture.

The question seemed to be decided, and the hypothesis of Kopp and Cannizzaro demonstrated, when some new experiments by H. Deville reopened the discussion. This eminent chemist discovered that bodies may decompose at a lower temperature than that of combination; that pure water, for example, in small quantities may decompose at a lower temperature than that which determines the combination of hydrogen with oxygen, and lower than that at which water decomposes in bulk. Hence he concludes that bodies possess at lower temperatures than their points of decomposition a tendency to decompose or to *dissociate*. And he supposes that in the experiments of Pebal, Wanklyn, and Robinson the decomposition of the compounds amounted to this, that even below 350° dissociation of small quantities of the salt took place, sufficient, however, to give rise to the phenomena of diffusion.

Deville made a still more decisive experiment. Having taken hydrochloric and ammoniacal gas, and heated them to 350°, he found that when a mixture was made the temperature rose to 394° in consequence of the combination of the two gases; and he concluded, therefore, that hydrochlorate of ammonia may exist in a state of vapour even at 394°.

The argument of Deville against the explanation of Cannizzaro may be reduced to this:—Sal-ammoniac really exists at 350°, since its elements, when brought together at this temperature, disengage heat.

These propositions, evident as they appear, are still open to one objection. Is the disengagement of heat always the index of a reaction—the proof of the formation of a new molecule? The experiments of M. Favre on the thermic effects of mixtures seem to prove the contrary. Having mixed water with sulphate of hydrogen considerably diluted, he observed the disengagement of heat: he observed the same thing on adding small quantities of water to concentrated solutions of certain salts, retaining their water of crystallisation. In such cases the disengagement of heat cannot be due to affinity; it must be due to some attraction differing from affinity. Why, then, may not the molecules of HCl and NH_3 at 350° exercise some mutual action causing the disengagement of heat, and still not be blended into a single molecule? Clearly, we may be allowed to believe that known facts justify a different explanation from that of M. Deville.

We now come to a point of the greatest importance—that of the true constitution of simple bodies. Simple bodies are compounds of molecules which represent two volumes, and which contain two atoms. Thus the molecule of hydrogen, the smallest quantity which can exist free or enter into a combination, is formed of two atoms of hydrogen, is H_2 or a hydride of hydrogen. It is the same with chlorine, iodine, bromine, oxygen, and, indeed, the greatest number of simple gases and vapours. In the reaction of chlorine on hydrogen we have

$$\boxed{H \mid H} + \boxed{Cl \mid Cl}$$

and after the reaction

$$\boxed{H \mid Cl} + \boxed{H \mid Cl}.$$

There has been, then, not combination, but double decomposition; for each volume of hydrochloric acid must contain one atom of hydrogen and one atom of chlorine, which is as much as saying that a molecule of hydrogen must have been halved. Such is the starting point of the theory we now proceed to establish, supporting it by chemical and physical considerations.

Let us first look at hydrogen. Suppose we take hydride of copper CuH, and drop it into a test-tube containing hydrochloric acid: cuprous chloride is formed, and there is a violent disengagement of hydrogen. But hydrochloric acid is not decomposed by copper, and how could it be by a compound of copper and hydrogen, unless the affinity of the copper for the chlorine was assisted by the affinity of the hydrogen for the hydrogen? The reaction is clearly $CuH + HCl = CuCl + HH$.

We may say in the same way that free oxygen is an oxide of oxygen, and that the molecular weight of the body is 32=2 atoms—a fact which the experiments of Clausius oblige us to admit.

MM. Favre and Silbermann have shown us that the combustion of carbon in protoxide of nitrogen disengages more heat than the combustion of the same body in oxygen. This, at first sight, very singular result is easily explained if we admit the duality of the molecule of oxygen. In both cases there is a decomposition, and the decomposition of the protoxide of nitrogen N_2O requires less heat than the decomposition of OO, and that is why the total heat produced is least in the latter case.

We know that oxygen and nitrogen combine in the eudiometer with difficulty, but if we add hydrogen to the mixture an appreciable amount of nitric acid is formed. We have in this case HH, OO, and N; at first there is formed (HH)O, and so the molecule of oxygen is halved, and the atom in the nascent state combines easily with the nitrogen.

Schönbein, on allowing water to fall drop by drop upon a plate of zinc, found the water to become charged with a small quantity of peroxide of hydrogen. How can we explain the formation of this substance under these circumstances? Our theory gives us the reason:—

$$OO + Zn + H_2O = ZnO + H_2OO.$$

OO is decomposed; one of the atoms oxidises the zinc, the other in the nascent state unites itself with the H_2O.

The remarkable reductions effected by oxygenated water come in to support our theory. Thus, oxide of silver is reduced to the metallic state; permanganate of potash is changed into manganic hydrate with the evolution of oxygen; and ozone is brought back to the state of ordinary oxygen. All these facts and many others, which have been for a long time explained by the action of simple contact—an action altogether incomprehensible—are much more easily explained on the supposition of the duality of the molecule of oxygen. We have, in fact, the following changes:—

$$Ag_2\overset{-}{O} + H_2O\overset{+}{O} = Ag_2 + H_2O + \overset{-}{O}\overset{+}{O}.$$

$$[MnKO_2\overset{-}{O_2}] + 2[H_2O\overset{+}{O}] = MnHO_2 + KHO + H_2O + 2\overset{-}{O}\overset{+}{O}.$$

$$[H_2O\overset{+}{O}] + \underbrace{O_2\overset{-}{O}}_{\text{Ozone.}} = \overset{+}{O}\overset{-}{O} + O_2 + H_2O.$$

Similar considerations will prove that the principle extends to other simple bodies. We may say, then, that the molecules of a great number of simple bodies, like those of compound bodies, represent two volumes, and contain at least two atoms.

ACADEMY OF SCIENCES.

August 4.

M. Boussingault contributed a paper "*On the Nitre Beds of Tacunga,*" in the State of Ecuador. Saltpetre, he remarks, is distributed in nature with astonishing profusion. It is found in rain, in snow, in hail, in dew, and in fogs; it is present in the water of rivers, and consequently in the ocean. It is found in the air, and in the earth. Whenever combustion takes place in the atmosphere there is generally some oxidation of nitrogen and some nitre compound formed. Nevertheless, the proportion is extremely minute The localities in which it is met with in abundance are very few, and in only one it forms a distinct layer, namely, in the province of Zarapsca, in Peru. Besides this the salt appears spontaneously under very different circumstances, all, however, indicating the intervention of organic matters. Sometimes it covers the soil with efflorescences which develope like a rapid vegetation. A few days ago the earth may have been black and moist, to-day it is white and pulverulent. The saltpetre may be removed by washing the soil, and if the meteorogical conditions remain favourable a second crop may soon be gathered. It is thus that nitre is obtained from the soil deposited by the inundations of the Ganges, and in some parts of Spain.

The conditions under which natural nitre beds occur, too, are very different. They are found in full sunlight on cultivated lands, in the shade of forests, and in the darkness of caverns. But in all cases the same agents produce them, organic matters, humus, and the same phenomenon takes place, slow combustion, and the oxidation of a small amount of nitrogen from the atmosphere Dry air and long immunity from rain seem to be indispensable conditions, and also the presence of the *detritus* of crystalline rocks to furnish the alkali. Wherever natural nitre beds are found the felspathic elements are always present.

The arable land of Tacunga is a fine sand, consisting of particles of trachyte and pumice coloured with humic matter. Some days after the rains cease the soil becomes covered with an efflorescence, which, as soon as it becomes thick enough, is removed and washed to extract the saltpetre.

M. Boussingault thought it of interest to examine the soil after the removal of the efflorescence, to ascertain what concurred in the process of nitrification These were taken for him at several places and various depths. We need not quote the whole of his analysis; it will be sufficient to say that a cubic decimetre of the soil, weighing 1200 grammes, contained 0·12 grms. of ammonia in the state of fixed salts; 11·70 grms. of nitric acid representing 21·91 grms. of nitrate of potash; 2·92 grms. of nitrogen in organic matters, forming a sort of reserve for the production of nitric acid or ammonia.

The author finds a curious analogy between the constitution of this earth and that of the best cultivated lands, and believes there is a real connexion between fertility and nitrification. This is not the first time we have published M. Boussingault's views on nitrification, but we may quote his closing paragraph. The origin of nitric acid in natural nitre beds, he says, resides in the slow combustion of azotized organic matters analogous to humus, and the brown acids of fertile soils—an origin very different from that of the nitric acid formed in the atmosphere (which is also an immense nitre bed) by the electric spark, and by the mysterious action of ozone.

M. Millon, who agrees with M. Boussingault as to the origin of nitre, had also a paper on "*Nitrification in Algeria.*" M. Millon looks on Algeria as having a climate favourable for the production of nitre in artificial beds; and he has made some experiments which strikingly confirm his view. He started with humus prepared artificially from wood, charcoal, or sugar, mixed this with vegetable and animal matters from the towns, and cautiously moistened the mass. In a few days he found nitre in the upper part of the mass, and observed that the quantity diminished the lower he went down. The climatic conditions of Algeria seem highly favourable to nitrification, and the author recommends that the country should be made a great nitre bed.

In a paper on the "*Hydrocarbons of Coal-tar,*" M. Beilstein announces his belief that the new hydrocarbon discovered by MM. Bechamp and Naquet is pure *xylene* C_8H_{10}. This body has been studied by Mr. Church and Dr. Müller, who differ about its boiling point, the former asserting that it boils at 126·2° and the latter at 140°. Beilstein confirms the experiments of Dr. Müller both as regards the boiling point and the compound obtained by reducing tri-nitro-xylene by means of sulphuretted hydrogen. Xylene may be obtained by collecting the product, which passes about 140°. It is purified by treatment with fuming sulphuric acid, which dissolves it, forming xylene-sulphuric acid. This is decomposed by heat, and pure xylene distils at 139°.

We have noticed from time to time the ideas which have been published on the propagation of contagious diseases by living ferments. MM. Leplat and Taillard now come forward with a paper "*On the Action of Bacteria on the Animal Economy.*" They have produced these beings in vegetable infusions, in liquids charged with decomposing animal matters, and in decomposed serum of blood, and have then injected the fluids into the veins of dogs, but they never found the animals any the worse for it. In one case, however, a large quantity of decomposing serum of ox blood killed a dog with dysenteric and convulsive symptoms, but the blood of this animal injected into the jugular vein of another produced no effect.

M. Perrin has experimented "*On the Influence of Alcoholic Drinks taken in Moderate Quantities on Nutrition.*" He found that less carbonic acid was exhaled from the lungs when wine was taken. His estimations of urea showed nothing particular. He believes with Dr. Smith and others that alcohol is not assimilated, but it affects nutrition by lessening the expenditure of material.

A recent *Comptes Rendus* contained an account of a French smuggler who was made very ill by carrying tobacco under his clothes. M. Gallavardin now contributes a paper "*On Poisoning by the Application of Tobacco-leaves to the Skin,*" in which he quotes several cases of poisoning by this means;—not fatal cases, however. We can supply him with another. We once saw a man brought out of the London Docks dead, with a large quantity of tobacco-leaves under his shirt and in his trousers. He was said to have been poisoned by rum, but the tobacco may have had something to do with his death.

NOTICES OF BOOKS.

The Chemical Processes of the British Pharmacopœia, and the behaviour with Reagents of their Products. By HENRY J. CHURCH, M.P.S. London: Hardwicke. 1864.

It has been a matter of some surprise to us that no work has appeared on the British Pharmacopœia of the same character as Mr. Phillips' translation of former London pharmacopœias. There is yet room for such a work, since pharmaceutists, and more especially the pharmaceutical student, is still left without a complete guide to the Pharmacopœia.

The work we now notice partly supplies the want we have indicated; but it is restricted entirely to an explanation of chemical processes. As such, however, it will be of great service to the pharmaceutical student, and we have much pleasure in recommending it. The following is a sample of its contents:—

"Ferri Arsenias.—Arseniate of Iron $3\,FeO, AsO_5$, partially oxidated.

"Three ounces of Acetate of Soda, and four ounces of Arseniate of Soda, dried at 300°, are dissolved in two pints of boiling Distilled Water, and nine ounces of Sulphate of Iron are dissolved in three pints of Distilled Water. The solutions are mixed, and the white precipitate collected on a calico filter, and washed until the washings cease to be affected by a dilute solution of Chloride of Barium. The washed precipitate is squeezed between folds of linen in a press, and dried in a hot-air chamber under 100°.

"The official Arseniate of Soda consists of two atoms of Soda and one of Water as base; that the result of its decomposition with Sulphate of Iron may be a basic Arseniate of Iron, another salt of soda must be laid under contribution for an atom of soda to take the place of the basic atom of water. The Acetate of Soda is chosen for this purpose, and when this and the arseniate of soda, both in solution, are added to the solution of Sulphate of Iron, the reaction is this:—

$$(2NaO,HO,AsO_5) + NaO,\bar{A} + 3FeO,SO_3 + xAq =$$
$$(3FeO,AsO_5) + 3NaO,SO_3 + A + HO + xAq."$$

At the end of the work the chemical substances of the Materia Medica are arranged in groups, and their reactions are succinctly given. As we have said, this will be a useful book to the pharmaceutical student.

International Exhibition. Jurors' Report. Class II., Section A. Industry of Manures.

In our notices of Dr. Hofmann's Report on Class 2, Section A, of the Exhibition, we referred incidentally to this chapter on manures, and announced our intention of leaving it for future consideration. The time is come when we may take up the subject, and give our readers the substance of this, in some respects, remarkable essay.

We may state that this portion of the Report must be looked upon as a distinct work, the production mainly of Mr. F. O. Ward. Much special information communicated to the general author of the Report has been incorporated, and the whole has received the full approval of Dr Hofmann. We have therefore to look upon the document as expressing the opinions of Mr. Ward endorsed by Dr. Hofmann.

It is not our intention to enter upon any detailed criticism of the essay, which, it must be remembered, is devoted as much to the philosophy of manuring as the industry of manures. We have recently (in a series of papers on the "Chemistry of Agriculture" in vol. vii. Chemical News) discussed some of the questions here debated, and need not now re-enter upon the discussion. We shall therefore content ourselves with laying before our readers the substance of the Report and the conclusions at which the reporters have arrived.

The first part is historical. Manures in the form of cattle-dung and farmyard composts have been used from time immemorial; but the manures termed 'artificial," which have their origin elsewhere than in the farm, have but of late years come largely into use. The British patent-rolls, the Report states, record the grant previously to 1800 of only three patents for manures, dated respectively 1721, 1729, and 1773. This, though a matter of small importance, is a mistake. Six patents were granted in the eighteenth century, of four of which the specifications are printed. Of the other two it would appear that no specifications were enrolled. Most of these are mixtures of common salt and lime; but one by Charles Neville, dated 1744, makes use of "cockle, oyster, and other sea-shells, burnt in a kiln with coals, wood, or any other fuel, but not quite so much burnt as for lime.'

The specification of Baron von Hake, dated 1779, it is remarked, affords a rough measure of the state of popular knowledge and opinion on the subject of manures towards the end of the last century. The Baron made a composition, which, to use the words of the specification, "consists chiefly of common salt, which is melted in an oven (made for that purpose) by a large coal fire until it is dissolved as thin and as fluid as water; then the same is fixed with saltpetre (which receives from the air a magnetic power, and communicates the same to the fluid), salt of unslaked lime, and salt of Rhenish tartar. When the said composition (so invented, found out, and prepared) becomes of a magnetic quality whereby it attracts fertility, and is (as aforesaid) productive of the effects of manuring arable land, meadow, and pasture ground." The last manure patent of the last century, taken out by the Earl of Dundonald in 1795, is for the use of sulphates and sulphurets of the alkalies.

The first patent of the present century was for dried excrement, and then comes another for pounded oyster-shells, gypsum, and heavy spar. After that, we have no other for thirty years, when we come (1835) to the patent for the well-known "Poudrette." From this time forward the patent rolls teem with manure patents, all but two, however, dated since 1840, the year in which Liebig published his work on "Organic Chemistry in its Applications to Agriculture and Physiology."

"The impulse given by Liebig's first book to manurial industry is very distinctly traceable in the registry of British patents.

"During the ten years which followed its publication, i.e., between 1840 and 1850, no less than thirty six patents for manurial processes and products were enrolled; being six times as many, in ten years, as had been obtained in all preceding time since patents were first granted.

"During the next five years this manurial movement went on in an accelerating ratio; no less than ninety-six more patents having been registered between 1850 and 1855. The lowering of the charge for patents, which occurred during this interval, no doubt had its share of influence on this result.

"The patent statistics since 1855 are not before the Reporter; but he is enabled to state, in general terms, that the activity of research and invention in this department has by no means declined during the last seven years, and that the manurial inventions brought forward in England since 1840 may be approximatively estimated as numbering at least 200.

"This long series of inventions comprises plans and processes for turning to account, as manure, almost all the known forms of animal waste and ejecta; such as, for example, the night-soil and sewage of towns; the rags of woollen, silken, and leathern clothing; the *debris* of manufactures in which horn, bone, hides, bristles, gut, and other organic and nitrogenous materials are used; the spent animal or bone-charcoal of the sugar refineries, and other phosphatic residua; the ammoniacal liquors of gas-works; the alkaline wash-waters of soap, dye, bleach, and many other factories; in a word, several hundred forms of residua—nitrogenous, phosphatic, and alkaline—formerly cast away as worthless rubbish.

"These the respective patentees propose to subject to various processes, mechanical, physical, and chemical; such as, for example, in the case of liquors, to concentration by boiling down, or precipitation by chemical agency; in the case of solid residua, to crushing, grinding, or other process of comminution; or to chemical disintegration by powerful solvents, acid or alkaline, according to the circumstances in each case; or to maceration in water; or to torrefaction by fire; or to digestion, at low or high pressure, sometimes in moist, sometimes in dry or superheated steam.

"Several of the patents include recipes for mixing the products thus obtained with each other, or with products of a different origin, to adapt them (as the inventors allege) for special crops, or for peculiar soils.

"Many of these proposals possess merit; though a still larger number exhibit ignorance on the projectors' part, while a certain percentage almost seem to have been concocted with a view to profit by the ignorance of others."

We must return for a moment to the predecessors of Liebig. Although the researches of many chemists bore more or less directly upon manurial and agricultural questions, there were two whose investigations and writings contributed immediately to the advancement of our knowledge of the subject. These were Lavoisier and Davy, and we may extract at length the eloquent passage in which the Reporter alludes to the influence of these two great men:—

"Among the many illustrious men who assisted Lavoisi probably deserves the highest place; not, perhaps, as the largest contributor of new truths to the accumulating store—though his contributions of this kind were many and brilliant—but because his vivid imagination, and the eminent generalising powers with which he was endowed, enabled him to co-ordinate all the scattered researches of his time, and to display innumerable isolated facts in their true subserviancy to general laws; so as (among other things) largely to extend our knowledge of the cosmic equilibrium on which sound husbandry can alone be based. Everything, indeed, that Lavoisier did, bore the impress of his master-mind. He it was who first applied the Balance to the study of the phenomena of Life. He it was who first showed that, while plants evolve oxygen, animals, on the contrary, consume it; carbon being oxidised or burned in their bodies as oil is burned in a lamp. His lofty tone of thought, and eloquent language, powerfully impressed his contemporaries; and chiefly to his influence and example the admirable researches of his age owe their high scope and scrupulous precision. Science never endured a severer loss than when Lavoisier met his untimely fate. But his great spirit 'lived after him,' and researches bearing upon the noble themes he had loved to treat were carried on, if possible, with increased activity after his death. The scientific records of Europe were soon crowded with fresh masses of undigested discovery; and in a few years such another mind as his was wanted, to grapple with the growing mass of detail, and once more to create order out of the scientific chaos.

"Early in the present century, England, in her turn, produced a master-mind—that of the illustrious Sir Humphry Davy—vast in scope and luminous in conception, as any, the greatest, of foregone times. Davy was well fitted to wear the fallen mantle of Lavoisier, and to continue his great work. It is, accordingly, to Davy's genius we owe that memorable treatise—truly described by Liebig as 'immortal'—the 'Elements of Agricultural Chemistry.'

"In that imperishable work all the scattered results of foregone research in this branch of science were collected and reduced to a system, which was extended and enriched by the author's own capital researches; whereof, perhaps, the most signal (in this department of science) were his analytical investigations of soils (types of all that has since been done in that way); his capital determinations of the composition and transformations of vegetal products; and his admirable experiments on the nutrition of plants, as well by leaf as by root.

"To the powerful impulse and just direction impressed by Lavoisier in France, and by Davy in England, on subsequent investigations of like kind, may be ascribed in a great measure their vigorous and successful prosecution by philosophers contemporary with ourselves."

Without denying to Lavoisier the honour of being the greater genius—perhaps the greatest chemical genius who has lived—we think we may still claim for Davy the honour of being the father of agricultural chemistry.

(To be continued.)

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1642. Thomas Nichols, New York, U.S.A., "Improvements in the preservation of eggs, and in apparatus to be used in connection therewith."—Petition recorded July 1, 1864.

1688. William Edward Newton, Chancery Lane, London, Middlesex, "An improved process for cleansing or clarifying impure water."—A communication from Carl Johann Auguste Scheerer, Freiberg, Saxony.—Petition recorded July 7, 1864.

1766. Richard Archibald Brooman, Fleet Street, London, "Improvements in the manufacture of fluoride of silicium."—A communication from Cyprien Marie Tessié du Motay and Edouard Karcher, Saarbruck, Rhenish Prussia.—Petition recorded July 14, 1864.

Notices to Proceed.

713. John Morgan, Stephen's Green, Dublin, "Improvements in the preservation of animal and vegetable substances, and in the fluids to be employed therein."—Petition recorded March 21, 1864.

745. Charles Garton, Bristol, and Thomas Hill, Southampton, "Improvements in washing apparatus."—Petition recorded March 24, 1864.

955. James Cane Coombe, Swinton Street, Gray's Inn Road, Middlesex, "Improvements in the preparation of fertilising agents for agricultural, horticultural, and other analogous purposes."—Petition recorded April 15, 1864.

1072. Thomas Goulston Ghislin, Hatton Garden, London, "Improvements in the treatment and application of sea-weed."—Petition recorded April 28, 1864.

CORRESPONDENCE.

Cavendish Society.

To the Editor of the Chemical News.

Sir,—Will you inform me through the medium of your Notices to Correspondents whether the 16th vol. of "Gmelin's Handbook" by the Cavendish Society is yet published? It was promised to be issued a month or so after the general meeting, but up to the present time I have heard nothing of it, although I am a subscriber.

I am, &c. "Rumex Patientia."

August 6, 1864.

[We publish this as a specimen of several communications we have received. We have not seen the volume.—Ed. C. N.]

Equivalent of Indium.

To the Editor of the Chemical News.

Sir,—In the paper on "Relations Between the Equivalents," published in your journal of the 30th ult., Mr. Newland states,—"We may almost predict that the next equivalent determined—that of indium, for instance—will be found to bear a simple relation to those of the group to which it will be assigned." Will Mr. Newland be kind enough to give us some idea of the equivalent of this new metal?

I am, &c.,
Inquirer.

London, August 9.

MISCELLANEOUS.

A New Complaint against the Pharmacopœia Committee.—Another peculiarity in the British Pharmacopœia is the complete ignoring of the United States as a commercial source of drugs, which is intensely English. For instance, Guaiac wood is referred to St. Domingo and Jamaica; kino to Malabar; rhatany to Peru; jalap to Mexico, but tobacco is cultivated in America. Serpentaria from the southern parts of North America; whilst senega, sassafras, podophyllum and lobelia are all attributed to North America, and Canada balsam, which is specially North American, is referred to Canada! It follows from this that, in British geography, North America is a country identical with the United States! — *American Journal of Pharmacy.*

ANSWERS TO CORRESPONDENTS.

Ph. D.—You are correct. It should have been *M. D.* after Dr. Muspratt's name in our last, not *Ph. D.*

A Reader.—The word "alcohol" was used to signify an impalpable powder, as well as spirit of wine.

J. Newlands—Studiosus.—Received. Will appear next week.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Combinations of Metal Ammonium, by W. Weyl.*

The author seeks to explain how far ammonia may be reconciled with the existence of ammonium, his arguments being greatly strengthened by a new ammonium which he has succeeded in producing, and also by the mode of its formation and decomposition.

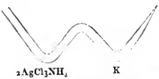
In starting he sought to obtain a mercuric oxide of ammonium, and to use this for the production of other compounds with electro-negative bodies. When dry ammoniacal gas, under pressure, is made to act on yellow oxide of mercury, a chemical compound is formed, containing 4 equivalents of oxide of mercury to 1 of ammonia; when prepared in perfect exclusion of light, it is of a yellow colour similar to the oxide itself; light renders it paler, and when dissolved in hydrochloric acid leaves a small portion of calomel undissolved; long exposure to light even leaves metallic mercury. In the air this new compound rapidly absorbs carbonic acid, and loses ammonia, the same taking place over sulphuric acid. Rapidly heated in a flame it becomes brown and explodes most vehemently; but by a very careful and gradual rise of temperature even 30 grains might be decomposed without explosion. If the three atoms of hydrogen in this body could be combined with the corresponding amount of oxygen and the product removed as water, an ammonium mercury would be left, wherein mercury had replaced the hydrogen.

By directing dry ammoniacal gas at a temperature of 212° (100) over this compound it was found possible to remove all the water. At 176° only two equivalents escaped, the removal of the last atom requiring the higher temperature during one to two hours, when it assumed a dark brown colour. The escape of the water was ascertained by the loss of weight of the glass tube containing the substance, and also by the increase in weight of the potash previously saturated with ammonia. On analysis this brown substance proved to consist of one equivalent of nitrogen, four of mercury, and one of oxygen, the latter being estimated as loss.

Like its hydrate, it decomposes by exposure to light and moisture, and evolves ammonia; water converts the hydrate quickly into a white powder, while the anhydrous substance resists longer, and becomes, first of all, converted into the trishydrate. The anhydrous substance is insoluble in dilute nitric and sulphuric acid, but is easily soluble in hydrochloric acid; but when produced under access of light, it leaves some insoluble subchloride. The tendency of this body to explode increases with its greater dryness, and when anhydrous it requires the greatest possible care in handling; mixed with a large excess of oxide of copper and gradually heated, it may, however, be decomposed without exploding, and its freedom from water proved. This compound has to be considered as oxide of tetramercur-ammonium, and if really possessed of basic properties it must easily show its tendency to combine with electro-negative bodies. The anhydrous salt was first exposed to the action of dry carbonic acid, but without effect; the hydrate, when similarly treated, absorbed the gas, developed heat, and perfect decomposition took place, and carbonate of ammonia sublimed, leaving oxide of mercury. By allowing the carbonic acid to act very gradually, this decomposition was avoided. For the production of the chloride, hydrochloric acid gas could not be used; but an alcoholic solution of hydrochloric acid gave better results. The brown anhydrate treated in the cold with this alcoholic solution swelled up without altering in colour and appearance, the resulting compound having, however, different chemical properties; it is insoluble in dilute nitric and sulphuric acids; boiled with potash or lime it evolves ammonia, and when analysed it is found to contain chlorine in place of oxygen, so that it must be considered as chlor-tetramercur-ammonium. It exploded also when heated on platina foil, but with less violence than the oxide. At a gradually increased heat 15 to 30 grains could be decomposed in a tolerably wide glass tube without shattering it to pieces; the decomposition was but partial; nitrogen, mercury, and chlorine formed, but the greater portion was left as a yellow heavy substance, similar in appearance to oxide of mercury, but resisting the most powerful reagents. Boiling nitric and sulphuric acids, and potash hardly acted upon it, but hydrochloric acid dissolved it readily. The iodide and nitrate were also prepared by means of alcoholic solutions of hydriodic and nitric acid acting on the anhydrous compounds; they possessed similar but less characteristic properties.

The above results might be taken as furnishing fresh proofs for the ammonium theory, especially when we assume that the hydrogen atoms, which the mercury displaced, occupy an analogous position; but a closer investigation of similar compounds leads to the conviction that the fourth atom of hydrogen occupies a perfectly different position. Many of the ammonium compounds, when heated, part either entirely or to a great extent with their ammonia, and I have strong reasons to believe that chlortetrammonium splits up into NHg_3 and $HgCl$. Sal ammoniac is formed by the direct combination of ammonia and hydrochloric acid, and according to Pebal separates again at a high temperature into these two compounds—nay, gives off ammonia even at ordinary temperatures. Further, the oxide of ammonium, which must be considered as present in moist ammoniacal gas, may by means of oxygen be easily deprived of its fourth atom of hydrogen, so that all this leads me to the conclusion that metal ammonium has to be considered as consisting of ammonia and hydrogen, and that by substituting an electro-positive metal for the fourth atom of hydrogen, ammonium could be prepared from ammonia.

For this purpose the closed end of a Faraday's tube was filled with potassium as free from oxide as possible, and the open end filled with chloride of silver saturated with ammonia and the aperture closed by fusion. The end of the tube containing the chloride of silver was now slowly heated to fusion in a chloride of calcium bath. In less than half an hour the potassium commenced to swell, and the portions nearest the silver became covered with small silvery balls, which assumed a darker and darker hue till they fused to a strong metallic copper-coloured mass. In an hour the whole potassium had this appearance—a concave surface, which



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* Abridged from *Poggendorff's Annal.*, vol. cxxi., No. iv., page 601.

by flowing along became convex. During the whole operation the chloride of silver had to be maintained in fusion, and the potassium protected against the heat and cooled.

When cold the chloride of silver again absorbs the ammonia, the potassium shrinks, loses its bulk, becomes paler, till it is again as silvery in appearance as before. This reconversion of both bodies requires about a day, but the experiment may be repeated with the same results. On breaking the tube the potassium presents a spongy, porous appearance. It is evident that during these reactions no amid can have been formed, which would have rendered the subsequent reconversion of the two bodies impossible; it must have been, therefore, a simple amalgamation of potassium and ammonium. To ascertain the nature of this amalgam, the following synthetical experiment was tried. First of all it was requisite to ascertain that less than equivalent quantities of ammonium and potassium did not give these reactions, which was the case. According to Rose, two equivalents of chloride of silver absorb three equivalents of ammonia; a Faraday's tube, open on both ends, was therefore filled in an atmosphere of hydrogen, with potassium and sufficient chloride of silver to absorb an equivalent amount of ammonium, which gas was directed through the tube itself, when both ends were closed as before. The experiment when repeated gave perfect results. In this instance one equivalent of ammonium acted on one equivalent of potassium, the compound must therefore have the formula—

$$N\left\{\begin{matrix}H\\H\\H\\K\end{matrix}\right.$$

potassium occupying the place of the fourth atom of hydrogen.

I reserve for a further investigation whether it is possible to prepare oxides and other salts from this compound, and to ascertain whether the ammonium replaces one atom of potassium in its molecule—

$$\left\{\begin{matrix}K\\K\end{matrix}\right.$$

An experiment made with sodium gave similar results; after the reaction and reconversion the sodium had a dull surface instead of the bright silvery appearance of the potassium. To prove the metallic nature of these compounds an amalgam of sodium and mercury was subjected to the same treatment; the pulverulent amalgam became firm, coherent, and appeared as a uniform homogenous mass with metallic lustre and bronze-like copper colour, it had, however, the same instability, and separated on cooling into ammonia, free mercury, and amalgam.

TECHNICAL CHEMISTRY.

On the Extraction of Potassa from Marl, *by* G. J. Scattergood.*

[We re-publish this process, thinking it possible that a similar source of alkali might be found available in this country.]

The green sand or marl of New Jersey, according to analysis, contains, among other constituents, from 10 to 12 per cent. of potassa. Query:—"Can this potassa be economically extracted sufficiently pure for pharmaceutical and commercial use, so as to compete in price with that derived from wood ashes?"

The experiments which have been performed in reference to this question require that it should be answered decidedly in the negative. The small proportion of potassa, and the very insoluble form in which it exists in the green sand, are insuperable obstacles to the latter ever becoming a cheap source of commercial potash. The results, however, which have been obtained are not entirely devoid of interest, since they show the effects of certain agents upon a substance whose chemical nature is yet but little known.

The earlier analyses of green sand have shown, as above stated, the large amount of 10 to 12 per cent. of potassa. But later investigations performed by improved methods have not confirmed their accuracy, but, on the contrary, have pointed to the fact that the alkali previously estimated as potassa only is in part soda, and that the average amount of the former throughout the green sand formation in New Jersey does not probably average more than 5 per cent.; and from but few specimens can as much as 7 per cent. be obtained. (Report New Jersey State Geological Survey, 1854.)

The green sand with which the following experiments were tried contained about 6 per cent. of potassa. It is from the second or middle of the three beds into which this deposit in New Jersey has been divided, and was dug on the land of David Marshall, near Blackwoodtown, Camden Co. An analysis performed by the general process for the analysis of soils has given the following result—viz.:—

	(I.)	(II.)
Insoluble silica	5	48·
Soluble silica	48·	
Protoxide iron	22·74	
Alumina	6·61	
Potassa	5·01	6·84
Soda	1·08	1·47
Lime	1·975	
Magnesia	1·375	1·
Phosphoric acid	4·821	
Water.	7·50	
	99·611	

The phosphoric acid was estimated as the biphosphate of magnesia. This specimen is in the usual form of small, distinct, green grains, soft enough when freshly dug to be crushed by the nail, but becoming harder on exposure to the air, and exhibiting under the microscope, when washed from adhering clay, a general resemblance in shape to the "casts" of the rhizopods and other minute marine animals. In order to separate the potassa from the green sand, I have tried several of the cheap and powerful chemical agents, carbonic, hydrochloric, and sulphuric acids, quick lime, and sulphate of lime.

Carbonic acid, though a weak acid, has been stated to be one of the readiest agents in decomposing green sand. But I have not been able to obtain by it any appreciable amount of potassa, and only a trace of iron and lime. The quantities used were 100 grains of green sand and 12 ozs. of water charged with carbonic acid.

Hydrochloric acid decomposes green sand, only after being boiled with it for several hours, or after contact with it for several days in the cold. The potassa is thus obtained as a chloride—an undesirable form—and in mixture with other chlorides, the separation from which is attended with considerable expense.

When green sand is treated with sulphuric acid the alumina, as well as the potassa, is dissolved, resulting in the formation of alum. As the quantity thus obtained is considerable, and as this substance has several times already been suggested as a commercial source of alum,

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* (*Proceedings* of the American Pharmaceutical Association.)

I have tried a number of experiments to ascertain the comparative yield. 3500 grains of green sand were treated with 1750 grains sulphuric acid (62 per cent.) diluted with water. The first crop of crystals weighed 630 grains, the second 200 grains, in all 830 grains. The mother liquors still being quite acid, were mixed with 1750 grains more of green sand, and yielded a third crop—306 grains of alum. Again adding a fresh portion of green sand (1750 grains), 100 grains more were obtained, making in all 1236 grains of alum from 1750 grains of sulphuric acid, and 7000 grains of green sand employed. A large quantity of the soft sulphate of the sesquioxide of iron was also obtained, capable of yielding a considerable amount of copperas on being reduced with metallic iron.

When the green sand had been previously roasted, the yield of alum was still greater, the protoxide of iron in the green sand being thus converted into the more insoluble sesquioxide, and thus rendered less capable of combining with the sulphuric acid. 1750 grains sulphuric acid (62 per cent.) treated with successive portions of roasted marl yielded 1686 grains of alum, and an amount of the sulphate of the sesquioxide of iron sufficient to produce 693 grains of copperas.

When the green sand was washed from the adhering clay, which in this case constituted about 9 per cent. of it, the yield of alum was not so great. A greenish crystallo-granular mass, apparently the bihydrated sulphate of the protoxide of iron, not observed in the preceding cases, was also obtained. 1750 grains sulphuric acid (62 per cent.) treated with successive portions of washed green sand produced 785 grains alum and 626 grains copperas.

It thus appears that, with a cheap source of sulphuric acid, the manufacture of alum from the green sand of New Jersey might, perhaps, be profitably carried on. And it may possibly hereafter be found that, within the limits of this formation itself in New Jersey, the material for furnishing a cheap supply of the acid exists, in the sulphuret of iron which is widely disseminated throughout certain sections of it, or in those compounds of iron, or of alumina and iron with sulphuric acid, which give those properties so injurious to vegetation to the so-called "poison," or "burning marls."

The state of combination in which the ingredients of green sand exist in it has been considered to be that of silicates. Pelouse has called attention to the power which sulphate of lime has in decomposing glass, a mixture of various silicates. With a view to ascertain whether sulphate of lime would have any effect in removing potassa from the green sand, 50 grains of it, 100 of green sand, and 4 ozs. of water were mixed together, and allowed to remain in contact two or three days. Upon evaporating the liquid to dryness, 6·31 gr. of solid matter were obtained, which contained only ·06 gr. of potassa, about $\frac{1}{100}$th of the amount existing in the quantity used, the remainder being principally sulphate of lime.

When green sand is treated with quicklime and water a very small amount of potassa is obtained. 100 grains quicklime, 100 grains green sand, and 4 ounces water were mixed together, and after standing in contact for seventy-two hours, the liquid was evaporated to dryness. The solid matter obtained, weighing 5¼ grains, contained but ·04 grains of potassa; alumina, protoxide of iron, and carbonate of lime constituting the remainder.

The form of combination in which the silica, the iron, and the other ingredients exist in the green sand has not been fully determined. This substance has been regarded as essentially a protosilicate of iron. But I have noticed that upon treating the grains with acid, without powdering them, after the green portion of them is entirely dissolved, the silica is left behind in the form of small white grains of the same shape as the original grains, and not in that state of fine division in which it would be if it had just been liberated from a state of combination. These grains of silica, after ignition, are readily soluble in a cold solution of potassa, from which facts it is inferred that the silica has not been combined with iron, &c., as a silicate; and that the green sand should not be considered as a mixture of various silicates. Whether the ingredients are in a state of combination at all, or merely in intimate mixture, remains unascertained.

It would appear that during that remarkable change which has resulted in the formation of these "casts" of minute marine animals, which the researches of Ehrenberg and the late Professor Bailey have shown these green grains to be, the silica has been deposited in the cavity of the shell upon or during the decay of the animal; while the green-coloured matter, consisting of iron, alumina, potassa, &c., has been gradually deposited in the shell around it by a kind of petrefactive process during the removal of its carbonate of lime.

PHARMACY, TOXICOLOGY, &c.

On Veratria from Veratrum Viride,
by S. R. Percy, *M.D.*[*]

Any quantity of the coarsely-powdered root of the veratrum viride is moistened with water and packed into a percolator; water acidulated with hydrochloric acid, sufficient to cover the root, and allowed to stand for twenty-four hours.

It is then allowed to percolate, and the first portion of the fluid, which contains most of the strength of the root, is kept by itself; fresh acidulated water is added, until the root is exhausted.

The latter liquid is evaporated to about one quarter of its former bulk, filtered, and the first portion of the percolate mixed with it; soda is then added so long as a precipitate forms. The precipitate is washed in a small quantity of cold water and dried: it is then treated with ether; the ether is filtrated off, and allowed to evaporate.

This mass is then treated with water acidulated with hydrochloric acid, filtered, and ammonia added so long as a precipitate forms; the fluid is filtered off; the precipitate washed in a small quantity of cold water, and mixed with a small amount of animal charcoal which has been previously moistened with a little alcohol.

The whole is put into a flask, and alcohol added to it; the flask is put in hot water, and the hot alcoholic solution filtered off and more alcohol added, which is treated in the same way.

The whole of the alcoholic solution is either distilled or evaporated, according to the quantity of alcohol used; and the soft mass that is left is treated with successive quantities of boiling water, acidulated with hydrochloric acid. This solution is filtered, and the alkaloid is precipitated with ammonia.

The precipitate, when dry, is treated with ether, filtered, and the ether allowed to evaporate slowly.

The alkaloid is in a semi-crystalline state of a slightly yellow tinge.

To prevent the excessive and painful sneezing caused by inhaling this alkaloid, I have found it advisable, when manipulating with it, to anoint the nostrils as far up as possible with castor oil, and to tie over the nostrils a piece of moistened sponge.

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[*] Extracted from a Prize Essay on "The Physiological and Medicinal Properties of Veratrum Viride."

As thus obtained, veratria from veratrum viride is, if precipitated, a pure white amorphous powder; if from the evaporation of ether, it is semi-crystalline and of a slightly yellow tinge.

It is of an acrid and burning taste, but is not very bitter. It is necessary to be extremely cautious in handling it, for if a very minute portion is breathed up the nostrils it excites violent sneezing, which is difficult to check, and occasionally produces alarming symptoms.

Its formula is probably the same as that of commercial veratria. $C_{34}H_{22}NO_{6}$ve.

If a small quantity of veratria be placed upon platina and held over a flame, it fuses at a gentle heat; if it be now removed, it solidifies as it cools, and becomes a semi-transparent yellow mass; but if the heat be continued it swells up, and is gradually dissipated. It is insoluble in water, but readily soluble in ether, alcohol, chloroform, and benzole.

It neutralises acids, and forms salts which are soluble in water; they are of an acrid and persistently burning taste, and produce a considerable degree of irritation if rubbed upon the skin.

For the purpose of experimenting, a given quantity of the alkaloid was dissolved in a given quantity of distilled water, with precisely sufficient hydrochloric acid to effect its solution.

1. *Potassa.*—Potassa produces in solution of hydrochlorate of veratria a copious, flocculent, dirty-white precipitate, which is not soluble in an excess of the reagent. If viewed immediately on precipitation by a low power of the microscope, it is seen in coagula; but if viewed after standing some minutes many short prismatic crystals will be seen amongst the coagula, which shortly disappear. The $\frac{1}{100}$th grain of this veratria is most readily detected by this reagent, and with the microscope $\frac{1}{1000}$th may be easily recognised. The carbonate of the alkalies acts in the same manner as potassa.

2. *Ammonia.*—The reaction is the same as with potassa, but the precipitate is slightly soluble in an excess.

3. *Nitric Acid.*—If concentrated nitric acid is brought into contact with this alkaloid it agglutinates into resinous looking lumps of a dirty-yellow colour, which slowly dissolve in the acid. If the alkaloid is first moistened with water and a small quantity of nitric acid then applied, it exhibits a yellow tint, but on the addition of water forms a colourless solution.

4. *Sulphocyanide of Potassium.*—A flocculent white precipitate insoluble in excess of the reagent.

5. *Chromate of Potassa.*—A light yellow amorphous precipitate, insoluble in an excess.

6. *Bichromate of Potassa.*—A copious dirty-yellow, amorphous precipitate, insoluble in an excess of the reagent, but soluble in nitric acid.

7. *Ferrocyanide of Potassium.*—A copious bluish-black, flocculent precipitate, soluble if a small excess of the reagent is carefully added.

8. *Ferricyanide of Potassium.*—An abundant greenish-yellow precipitate, soluble in an excess.

9. *Iodide of Potassium.*—A dirty-white amorphous precipitate becoming a dirty greenish-white upon standing some time.

10. *Iodine in Iodide of Potassium.*—A copious reddish-brown, amorphous precipitate, soluble in liquor potassæ.

11. *Bromine in Bromohydric Acid.*—A dull yellow amorphous precipitate.

12. *Carbazotic Acid.*—A greenish amorphous precipitate, which, upon standing a short time, becomes a greenish-yellow.

13. *Bichloride of Platinum.*—A dirty yellow amorphous precipitate.

14. *Bichloride of Mercury.*—A white precipitate.

15. *Tannic Acid.*—A dirty white amorphous precipitate.

16. *Terchloride of Gold.*—A canary yellow amorphous precipitate, insoluble in an excess of the reagent, and insoluble in acetic acid, except upon the application of heat.

17. *Sulphuric Acid.*—This test should always be applied to the alkaloid or its salts in a dry state. If a small portion of the alkaloid is touched with a drop of strong sulphuric acid no colour is immediately developed, but in the course of a minute a yellowish-red, and then a beautiful bright red colour appears. This colour will appear immediately upon touching the veratria with the sulphuric acid if the slide upon which it is placed is warmed. The colour is not destroyed by heat, but it disappears after standing two or three hours; the colour will disappear in fifteen minutes if a small crystal of bichromate of potash is stirred upon the mixture.

Professor Wormly has by this reagent detected $\frac{1}{50000}$th of a grain of purified commercial veratria.

This last reagent—sulphuric acid—is the only one of all these that can be deemed decisively confirmatory of the presence of veratria; the other reagents are common to so many organic substances that they can only be regarded as confirmatory in connexion with the action of sulphuric acid.

There is but one substance with which it would be at all likely to be confounded by this reaction of sulphuric acid, and that substance is salicine. Sulphuric acid produces a red colour on solanine, narceine, papaverine, and piperine, but, as with salicine, the colour is produced immediately upon the contact of the cold acid.

But the reaction of sulphuric acid upon salicine and veratria differs, for whereas on salicine the colour is immediately produced upon the application of sulphuric acid on a cold slide, we have seen that the colour does not appear for a minute or more with veratria unless the slide or the acid is warmed.

The colour produced is also different, for with veratria it is, for a moment, a yellowish and then a beautiful bright red, then an intense blood red colour; with salicine it is more of a purple red. There is the difference between the two colours that there is between bright arterial and venous blood. The colour produced upon veratria lasts but two or three hours, while that produced upon salicine lasts double that time.

But the behaviour with other reagents would definitely settle the point if doubts were excited.

In a correspondence with Geo. J. Scattergood, of Philadelphia, on this subject, he says:—

"By treating commercial veratria with ether, I have separated it into two substances. That portion insoluble in ether behaves with sol. of iodo-hydrarg. potass., and with tr. iodine, on a muriate boiling, and sal ammonia added while yet warm, differently from the way pure veratria does. Veratria, soluble in ether, gives a beautiful pink, red, or crimson colour with sulphuric acid, and butyric acid smell; the matter insoluble in ether gives a darker colour, a greenish or brownish red, and a musky odour."

It will thus be seen that in following the experiments of Professor Wormly with veratrie obtained from veratrum sabadilla, we have obtained almost identical results with the veratrie we have made from veratrum viride, and have thus confirmed Mr. Richardson's observations, that the two alkaloids were identical in their chemical reactions.

PROCEEDINGS OF SOCIETIES.

LECTURES ON CHEMICAL PHILOSOPHY.—IV.

Delivered at the College of France, by M. A. Wurtz.

(*Continued from page* 81.)

Compound Radicals.

A celebrated chemist has said that "organic chemistry is the chemistry of compound radicals," wishing to indicate thereby that compound radicals play in organic chemistry the same part that elements play in mineral chemistry. We now know that this is not correct, and that compound radicals belong as much to mineral as to organic compounds. It is not less true, however, that the theory of organic radicals has exercised an important influence on the progress of the science, and particularly of organic chemistry.

Let us, therefore, trace the history of the question so as to see the connexion between the new and the old ideas.

The idea of *radicals* dates from Lavoisier. He supposed that ternary organic compounds of carbon, hydrogen, and oxygen might be regarded as oxides of binary radicals with two bases; that the quarternary compounds of carbon, hydrogen, oxygen, and nitrogen might be oxides of radicals with three bases. The radicals of Lavoisier, however, were hypothetical. The great master was restricted to this qualitative indication of their nature, for their true composition was not known in his time, and not one of them had been isolated.

The first discovery which gave some consistence to the idea of radicals was that of cyanogen by Gay Lussac in 1814. Cyanogen is composed of an atom of nitrogen, N, and an atom of carbon, C,[*] or of one equivalent of nitrogen, N, and two equivalents of carbon, C_2 ($CN = C_2N$). Cyanogen exists in the free state; it combines directly with simple bodies to form compounds resembling the binary compounds of chlorine, bromine, &c.; in a word, it plays a part exactly analogous to that of an element. These are the distinctive characteristics of a true radical.

This discovery had a very important influence on the later developments of chemistry.

In 1828, Dumas and Boullay demonstrated that olefiant gas, or etherine, might also be considered as a sort of radical capable of entering directly into combination with the elements of water to form alcohols and ethers. Olefiant gas (represented in equivalents) being C_4H_4, we have according to them the following series:—

Olefiant gas	C_4H_4
Ether	C_4H_4,HO
Alcohol	$C_4H_4,2HO$
Hydrochloric ether . .	C_4H_4,HCl
Acetic ether	$C_4H_4,C_4H_3O_3,HO$

Dumas and Boullay compared this series with the ammoniacal series having for radical NH_3, which they formulated thus:—

Hydrate of ammonia . .	NH_3,HO
Binhydrate of ammonia .	$NH_3,2HO$
Hydrochlorate of ammonia .	NH_3,HCl
Acetate of ammonia . .	$NH_3,C_4H_3O_3,HO$

The two series are perfectly similar and, to say the truth, parallel. But, independantly of this theory of the constitution of ammoniacal salts, there exists another which is founded upon the existence of the curious compound which is known as ammonium amalgam. We know that this may be formed either by electricity or in the moist way. In the hands of Ampère and Berzelius, this discovery became the source of a new interpretation of the facts relating to ammonia.

The amalgam of ammonium is formed according to the equation

$$NH_3,HCl + HgK = KCl + NH_4Hg.$$

In the body NH_4,Hg we may admit the existence of the group NH_4. This group has never been isolated; but as it enters into combination with mercury without destroying its metallic lustre, we are to some extent justified in comparing it to a metal. And if we admit the existence of such a group as NH_4 in the ammoniacal compounds, these become comparable to the compounds of a metal—potassium, for example:—

$(NH_4)O$	KO
$(NH_4)O,HO$	KO,HO
$(NH_4)Cl$	KCl
$(NH_4)O,C_4H_3O_3$	$KO,C_4H_3O_3$.

This analogy between the ammoniacal salts and the salts of potassium is supported by a number of facts, among which it is only necessary to notice the isomorphism of the chlorides and the chloroplatinates.

M. Chevreul has raised an important objection to the ammonium theory. We can admit, he says, the existence of the ammonium group NH_4, and that the hydrochlorate NH_3HCl is a chloride NH_4Cl; but how can we suppose that hydrochloric acid, a very stable compound of two elements having a strong reciprocal affinity, can part with its hydrogen to give rise to the group NH_4, so unstable that it cannot exist in a free state?

This objection is well founded, and would be unanswerable, if we wished to regard chloride of ammonium as containing ammonium on the one side and chlorine on the other. But we must remember that in chemical combinations all the atoms exert an action one upon another. In hydrochlorate of ammonia, the affinity which resides in the chlorine is satisfied not by such and such atom of hydrogen, but in some way by the resultant of all the affinities which reside in the other elements; and we can imagine that the nitrogen on its part also contributes to establish the molecular equilibrium. When HCl combines with NH_3 we cannot assert that the hydrogen remains combined with the chlorine. All we know is that the result of the combination contains six atoms, whose affinities respectively saturate each other.

The idea of ammonium became the starting point of a new theory of alcohols and ethers. Berzelius supposed in these compounds the existence of a radical C_4H_5, which he named *ethyle*. This radical is exactly comparable to potassium; it behaves like a simple body, and may be transported entire from one compound to another. We can, in fact, establish a complete parallel between the compounds of ethyle and those of potassium.

$(C_4H_5)O$, ether, oxide of ethyl.	KO, oxide of potassium.
$(C_4H_5)O,HO$, alcohol, hydrate of oxide of ethyle.	KO,HO, hydrate of oxide of potassium.
$(C_4H_5)Cl$, chloride of ethyle.	KCl, chloride of potassium.
$(C_4H_5)O,C_4H_3O_3$, acetate of ethyle.	$KO,C_4H_3O_3$, acetate of potassium.
$(C_4H_5)O,HO$; S_2O_6, sulphovinic acid or acid sulphate of ethyle	KO,HO,S_2O_6, acid sulphate of potassium.

Unfortunately, this radical, C_4H_5, cannot be isolated; it only exists in a state of combination, and when set at liberty its molecule divides.

We must say the same of benzoyle, introduced into organic chemistry by Liebig and Wöhler about 1828. By passing chlorine into the essential oil of bitter almonds, $C_{14}H_6O_2$, they obtained the compound $C_{14}H_5O_2Cl$, which they called chloride of benzoyle. By heating this chloride with cyanide of potassium they formed

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[*] We shall follow the Lecturer by indicating the double atom by means of *italic capitals*.

$$C_{14}H_5O_2Cy \text{ and } KCl.$$

By acting on the chloride with sulphide of lead they also formed a sulphide, $C_{14}H_5O_2S$, by double decomposition,—

$$C_{14}H_5O_2Cl + PbS = PbCl + C_{14}H_5O_2S.$$

Under the influence of NH_3 the chloride of benzoyle undergoes another metamorphosis. This also is effected by a double decomposition, and we have—

$$C_{14}H_5O_2Cl + NH_3 = HCl + C_{14}H_5O_2NH_2.$$

This last compound is amidide of benzoyle or benzamide. These various reactions show us a ternary group behaving like an element, in so far as it lends itself to double decompositions and passes entire from one compound to another. But, we must repeat, this group has never been isolated.

This conception of radicals, however, differs from that of Dumas and Boullay. It marks a new phase in the development of the theory. Berzelius at first received it with enthusiasm, then he rejected it. Faithful to his dualistic notions, he imagined that benzoic acid was the hydrate of a tritoxide, $(C_{14}H_5)O_3 + HO$, comparable to acetic acid, $(C_4H_3)O_3 + HO$. To him the radicals were hydrocarbides, which united with oxygen in the same way as metals. Liebig and Wöhler, on the contrary, represented these two acids, the former by $[(C_{14}H_5O_2)O,HO]$, and the latter by $[(C_4H_3O_2)O,HO]$.

The formulæ of Berzelius are hypothetical; those of Liebig and Wöhler are supported by experiment; they represent reactions.

The discovery of *cacodyle* by Bunsen gave a fresh impulse to the theory of radicals. Cacodyle is the name Bunsen gave to the radical of the fuming liquor first obtained by Cadet about 1750 by the distillation of arsenious acid and acetate of potash. Bunsen isolated this cacodyle $As(C_2H_3)_2$, and found that it possessed all the properties of a radical; that it combined with oxygen to form an oxide, the fuming liquor of Cadet, an acid $[As(C_2H_3)_2O_3]$ comparable to SO_3.

Cacodyle realises as completely as cyanogen the idea of a compound radical. Not only does it pass intact from one combination to another, not only does it lend itself to double decompositions, but it possesses the more important attributes of a simple body, it can be isolated and enter into direct combination with other bodies. The great objection which had been brought against the theory of radicals was thus upset; all radicals are not creatures of the imagination, for cyanogen and cacodyle can alone exist. To isolate the others became the work of the future.

Gerhardt was far from thinking so. He rejected the idea of considering cyanogen, cacodyle, and benzoyle as radicals, and tried to explain the metamorphoses in which these groups participated in another way. On this account he undertook those experiments which led him to the adoption of his memorable theory.

As far as regards the benzoic compounds, he arrived at the conclusion that chloride of benzoyle is no other than the hydride of benzoyle, in which the hydrogen is replaced by chlorine, and not the chloride of a radical. The hydride is C_7H_6O, and the chloride $C_7(H_5Cl)O$.† If we act on this chloride by ammonia, we have, according to Gerhardt, the following metamorphosis:—

$$C_7(H_5Cl)O + NH_3 = ClH + (C_7H_5O),(NH_2).$$

There is a double decomposition, the formation of HCl and the production of two residues—NH_2 and C_7H_5O—which combine at once to produce the compound $C_7(H_5,NH_2)O$, or benzamide.

The reaction of water upon chloride of benzoyle is analogous:

$$C_7(H_5Cl)O + H_2O = C_7H_5O.HO + HCl.$$

Here there is again a double decomposition, which is ended by the combination of two *residua*—HO and C_7H_5O.

So in the formation of nitrobenzine:

$$C_6H_6 + NHO_3 = C_6H_5(NO_2) + H_2O.$$

Again, in the formation of sulphovinic acid:

$$C_2H_6O + H_2SO_4 = H_2O + C_2H_6.SO_4$$

Gerhardt admitted that these residua which enter into combination often unite in a peculiar way, and that the products which they engender present odd properties. Thus sulphuric acid precipitates baryta, while sulphovinic acid does not; chloride of potassium precipitates salts of silver, but chloride of ethyle does not. The illustrious chemist explained this by supposing a special mode of combination, which he called *copulation*. Sulphovinic acid and chloride of ethyle, he said, were *copulated* or *conjugated* compounds.

This idea was the source of much discussion, the influence of which, it must be confessed, has been but small. There is no occasion, in fact, to have recourse to the idea of copulation to assign a reason for the facts relating to sulphovinic acid and chloride of ethyle. If the former does not precipitate baryta it is because sulphuric acid exists no longer.

$$\text{Sulphuric acid} = \left.\begin{matrix} SO_2 \\ H_2 \end{matrix}\right\} O_2$$

$$\text{Sulphovinic acid} = \left.\begin{matrix} SO_2 \\ H \\ C_2H_5 \end{matrix}\right\} O_2$$

In $\left.\begin{matrix} SO_2 \\ H_2 \end{matrix}\right\} O_2$ the H_2 are replaceable immediately *in the cold* by Ba. This substitution is no longer possible in the cold when H is replaced by C_2H_5. But everybody knows that it is only necessary to heat sulphovinic acid to the boiling point to regenerate the sulphuric acid.

If chloride of ethyle does not precipitate nitrate of silver it is partly from the circumstance that it is an insoluble gas. If, in place of chloride of ethyle, we take the iodide, and replace the aqueous solution of nitrate of silver by an alcoholic solution with which the iodide can mix, then the precipitation takes place.

The idea of Gerhardt, then, respecting copulation is sterile, and may be forgotten; but his conception of residues has been productive, and will remain. He has shown, in fact, that these residues are incomplete molecules, *débris* of molecules, which can play the parts of simple bodies,—that is to say, enter into a body or go out of it intact—be substituted for simple bodies, &c. The residues are to him, indeed, only radicals; but instead of considering them as bodies able to exist free and alone, he maintains that they are bodies in which the molecular equilibrium is broken, and consequently they are unable to exist by themselves.

Frankland, however, in 1849, succeeded in separating ethyl from the iodide. Gerhardt immediately examined the new gas (for it is a gas), and he maintained that free ethyle is not

$$C_2H_5, \text{ but } \left.\begin{matrix} C_2H_5 \\ C_2H_5 \end{matrix}\right\} = C_4H_{10}$$

that is to say, it is a double molecule. He supported his view by the fact that Frankland's ethyl is incapable of giving rise to ethylic compounds—which proves incidentally that the affinity which binds together the two ethylic groups in

$$\left.\begin{matrix} C_2H_5 \\ C_2H_5 \end{matrix}\right\}$$

is much stronger than that which binds together the two atoms of hydrogen. Thus so far as ethyle is concerned his theory is safe. C_2H_5 does not exist in the free state.

But there are bodies which play the part of compound radicals, and possess all the attributes of a radical. Without mentioning cyanogen and cacodyle, we may rank among the number of radicals sulphurous acid gas, and carbonic oxide. These bodies can enter into direct combination either with chlorine or with oxygen.

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† The lecturer here returns to the new notation.

$SO_2.Cl_2$ chloride of sulphuryle.
$SO_2.O$ sulphuric acid.
$CO.Cl_2$ chloride of carbonyle.
$CO.O$ carbonic acid.

The idea of compound radicals then is real. Some are residues which only exist in combination, but which can pass from one compound to another. Others can exist in the free state, and enter directly into combination; but these also are residues and only function as radicals because they constitute incomplete molecules. We shall pursue this idea further hereafter.

ACADEMY OF SCIENCES.

August 8.

MM. DAMOUR and H. Deville contributed a new analysis of the rare mineral *Parisite*. This mineral is composed of a mixture of the carbonates and fluorides of cerium, didymium, lanthanium, and lime. A detailed account of the analysis is given, which we shall soon extract at some length, since it contains a new method of separating the above-named metals.

M. St. Edme gave an account of "*Some Experiments relating to Electrolised Oxygen.*" The following are the principal facts mentioned:—The oxygen obtained when water but *slightly* acidulated is decomposed has no effect on Schonbein's paper, neither has the oxygen from the strongest hydrated sulphuric acid $(SO_3)_2,HO$. In the latter case the acid is decomposed, for sulphur appears at the negative pole. On the contrary, when the ordinary acid of the laboratory is employed, the oxygen strongly affects the papers.

Fused chromic acid decomposed by the battery gives oxygen which does not affect the test paper, which is also the case when a dilute solution of the acid is electrolysed; but when a saturated solution is decomposed, active oxygen is obtained. The oxygen evolved when chromic acid is decomposed by heat is also active.

The oxygen obtained when glacial phosphoric acid slightly moistened is decomposed, acts on the papers; that from a weak or even a strong solution of the acid will not act.

Moistened potash and soda yield active oxygen, while concentrated solutions of them do not. These facts, the author says, seem to indicate that the oxygen obtained by electrolysis from a binary compound is not ozonised. The ozonised state is only manifested when the decomposing action of electricity has to overcome a double chemical affinity, which, in the preceding cases, were—1. The mutual affinity of the oxygen and hydrogen; and 2, that of the water for the acid or the base. The author infers, therefore, that the property of ozone is only a difference in the dynamic condition of oxygen, and not a chemical or physical transformation.

M. Salvétat presented a note "*On the Estimation of Oxide of Cobalt.*" After separating the oxide by the known methods, the author recommends that, instead of reducing it in a current of hydrogen, it should be calcined with a known weight of alumina, or better, of a salt of alumina, which, after the calcination, leaves a known proportion of residue. The increase of weight will represent the cobalt in the state of protoxide.

M. Friedel communicated a "*New Process for the Preparation of Allylene.*" The author has found that chlorated propylene, C_3H_5Cl, which is easily obtained by the action of perchloride of phosphorus on acetone, answers well for the preparation of allylene. He heats it in a sealed tube with an excess of ethylate of soda. After eighteen hours' exposure at 120°, a large quantity of allylene escapes on opening the tube.

M. Menschutkin contributed a memoir "*On the Action of Chloride of Acetyle on Phosphorous Acid.*" The author first notices a remarkable difference between the neutral salts and ethers of phosphorous acid. In the neutral salts the metals only replace two atoms of hydrogen; in the neutral ethers the alcoholic radicals replace the three atoms of hydrogen of the phosphorous acid. It is the same with several organic acids. The study of lactic and other analogous acids has led to the notion of a hydrogen which has been named *alcoholic*, which cannot be replaced by metals, but may be by alcoholic radicals or acids. With the view of obtaining the acid $P(C_2H_3\Theta)H_2\Theta_3$ which should exist if phosphorous acid contained alcoholic hydrogen, the author investigated the reaction of chloride of acetyle on phosphorous acid. The reaction, however, was different. One equivalent of each body was heated to 120° in a sealed tube for fifty hours. The tube being opened two or three times allowed large quantities of hydrochloric acid to escape. When the reaction was finished a white crystalline mass was left, which was dried in a current of carbonic acid gas to get rid of hydrochloric and acetic acids. The mass dissolved in water, forming a strongly acid solution, which on saturation with potash and evaporation yields large oblique, rhomboidal prisms of a salt of a new acid the author proposes to call *acetopyrophosphorous acid*, the composition of which is—$P_2(C_2H_3\Theta)H_3\Theta_5 + 2H_2\Theta$.

The reaction may be represented as follows:—

$$2PH_3\Theta_3 + 2C_2H_3\Theta Cl = P_2(C_2H_3\Theta)H_3\Theta_5 + C_2H_4\Theta_2 + 2HCl.$$

As regards the constitution, the author considers it pyrophosphorous acid—

$$\left.\begin{matrix}P_2\\H_4\end{matrix}\right\}\ \Theta_5$$

in which one atom of hydrogen is replaced by acetyle—

$$\left.\begin{matrix}P_2\\(C_2H_3\Theta)H_2\end{matrix}\right\}\ \Theta_5.$$

A paper "*On the Separation of Titanic Acid and Zircon,*" by M. Pisani, is a valuable contribution to analytical chemistry, which we shall give at length in an early number.

MM. E. Millon and Commaille gave an account of "*A New Albumenoid Substance in Milk.*" They separated casein from cow's milk by means of acetic acid, filtered the liquor, then heated it, and obtained a new coagulum which they found to possess the external characters of albumen, and also to contain the same amount of nitrogen. They call the substance provisionally *lactoproteine*. There appears to be but a small quantity of this substance present in milk, but it may be precipitated by the careful addition of acid nitrate of mercury.

NOTICES OF BOOKS.

Zeitschrift für Analytische Chemie. Edited by Dr. R. C. FRESENIUS. Heft I. 1864.

THIS number of one of the most useful of chemical journals contains several papers of considerable interest, to which we shall have to return, so we shall give now only the titles. The first, by Werther, *On the Estimation of Thallium*, we have noticed before in the *Journal für prakt. Chemie.* The next paper is Dr. Mohr, *On the Estimation of Carbonic Acid*, for which purpose he makes use of baryta water. A process is also given for estimating in mineral waters in one operation the free, the combined, and the half-combined carbonic acid by means of baryta water and chloride of barium. As this paper has some practical interest we shall abstract it. *Researches on the Chemical Composition of Wood-Gas* is a valuable contribution to our knowledge of the condensible products in this gas. In a note *On the Appearance of Fluoric Acid in Elementary Analysis*, Kraut mentions that he has sometimes found fluoric acid in the chloride of calcium tube derived from the asbestos plug made use of. A paper *On the Quantitative Estimation of Cyanogen in Bitter Almond*

Water, by S. Feldhaus, will have much interest to Continental pharmaceutists and physicians, but owing to the limited use of the article in this country is of small importance to us. The most interesting paper in the number is one *On the Sublimation of the Alkaloids, &c.*, by Dr. Helwig, in which the author shows that morphia, strychnia, brucia, veratria, aconitia, atropia, solanin, and digitalin may be sublimed, and the microscopic appearance of the sublimate serve for the recognition and identification of these alkaloids. To this and another paper by the same author *On the Use of the Microscope in Toxicology* we shall shortly return. The only other paper we need notice now is a *Contribution on the Method of Estimating Ammonia and Nitric Acid by a Bromated Solution of Hypochlorite of Soda*, by Kroeker and Dietrich.

A Class Book of Rudimentary Chemistry. By the Rev. George Pope, M.A., &c., &c. London: Stanford. 1864.

This is a very small book, intended for the use of the compiler's own classes at Hurstpierpoint College, preparatory to their using the text-book in Chambers' Educational Course. "Definitions and statements have, therefore," says the compiler, "been put in the briefest and most dogmatic form . . . and strict scientific accuracy has consequently been sometimes sacrificed."

The book is an attempt at simplifying the elements of chemistry. We have some doubts whether the author has succeeded in making matters clearer upon all occasions, but the attempt is to be commended, and the book will be found useful in schools.

NOTICES OF PATENTS.

2551. *Separating Sugar from Molasses, &c.* Fédor de Wyloé, Trinity Square, Tower Hill. A communication from Dr. Henry Schwartz, of Breslau, in Prussia. Dated October 17, 1863.

These improvements refer to a process of separating molasses and other impurities from sugar crystals, and are also applicable to the refinement of the concentrated and crystallised juice of the sugar-cane, beet-root, or other sacchariferous plants. The invention is thus described by the patentee:—

"I take raw sugar from sugar-cane, beet-root, or other sacchariferous plants, and ascertain (by combustion and subsequent saturation of the ashes with an acid) the quantity of organic salts of lime and alkali which are contained therein. For every part of ashes obtained I reckon ten parts of molasses are present in the raw sugar. Having thus ascertained the quantity of acid necessary for saturating the ashes, I add the same proportion to decompose the molasses in the raw sugar with the inorganic acids and salts of the alkalies. Any acids may be used which form with the lime or alkali salts which are soluble in alcohol, methylated, or wood spirits. By preference, I take muriatic or acetic acid. A mixture of alcohol, or methylated spirit, with a due proportion of water and the necessary acid, will dissolve all the molasses, and leave behind crystals of sugar perfectly white and free from all impurities."

Having broken up the raw sugar in a suitable mill, the inventor proceeds to mix with it the spirit and acid according to the following directions:—"The spirit should be used of such strength as to contain about 80 per cent. of absolute alcohol. A raw sugar which leaves on burning 1 per cent of ashes, and consequently contains 10 per cent. of molasses, demands 1½ per cent. of muriatic acid of commerce, and 24 per cent. of the alcohol or methylated spirit already specified, but stronger or weaker solutions may be used according to circumstances. In this menstruum the molasses only are dissolved, the crystals of pure sugar being insoluble or very slightly soluble therein.

"I now separate the acid solution of the molasses from the sugar crystals by filtration, or by a centrifugal machine with suitable perforations worked at a moderate speed. The liquid which still adheres to the crystals may be removed by treating them with neutral alcohol or methylated or wood spirit, which may be caused to pass through the crystals very rapidly in the same rotatory vessel. The alcohol or methylated spirit should be increased in strength as this operation proceeds, until at last absolute alcohol or methylated spirit should be used as the final menstruum. The crystals so produced should be dried in a current of hot air. During the process I collect the alcohol by passing the atmospheric air charged with the volatilised spirit through or over water by any suitable arrangement. The neutral alcohol or methylated spirit by a proper system of working may be used several times, and when too highly charged with impurities can be used for mixing with the acid and water for the primary operation. The spirituous solution of molasses can also be distilled (after the addition of lime to neutralise it) and thus the alcohol may be regained without loss. By adding an excess of lime to the alcoholic solution of molasses a precipitate is formed consisting of sugar and lime, which on decomposition by carbonic acid will yield a solution of sugar, and thus a further per centage is gained from the molasses."

The invention above described is stated to have been made the subject of a patent claim likewise in France; and since the date of the foreign specification the principle upon which it is based has received the sanction of M. Dumas, who proposes to employ a mixture of acetic acid and alcohol in the valuation of sugar samples upon which a duty has to be levied. In the treatment of an inferior description of raw sugar known as "Mauritius brown," we found no difficulty, by working this process on a small scale, in obtaining upwards of 90 per cent. of sugar crystals of a very pale brown colour, besides the molasses liquor, which could afterwards be fermented and distilled, or otherwise worked to advantage. By operating upon a superior quality of brown sugar we obtained perfectly white crystals. The excise regulations of this country must be a bar to the employment of pure alcohol, which appears to give much more satisfactory results than the cheaper wood naphtha or methylated spirit; the use of either of the latter imparts an objectionable odour and flavour to the product, which cannot be got rid of even by drying the sugar in a current of warm air. In our own trials it seemed preferable to maintain the ordinary atmospheric temperature throughout the process of refining, the moist sugar crystals being so easily liquified by the application of even a moderate heat. We presume the expression "absolute alcohol" made use of in the latter part of the specification is not intended to bear the strict meaning which chemists would attach to it, but refers to an ordinary quality of alcohol or methylated spirit which for this purpose is not required to be mixed with additional water or employed conjointly with acid. But for our system of duties this would be a valuable process, and even now might no doubt be used with advantage in the colonies.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1780. Israel Swindells, Wigan, Lancashire, "Improvements in obtaining hydraulic and other cements from residuums or wastes."—Petition recorded July 15, 1864.

1784. Amélie Angelina Bonnet, Rue de la Fidélité, Paris, France, "Certain improvements in the mode of preparing and applying chemical fumigations to the treatment of human diseases, and in apparatus connected therewith."

1786. John Clayton, West Bromwich, Staffordshire, "Improvements in furnaces for heating and melting iron and steel, and for other purposes."

1789. Andrew Barclay, Kilmarnock, Ayrshire, N.B., "Improvements in the manufacture of pig iron and in the machinery or apparatus employed therein."—Petitions recorded July 16, 1864.

1799. Antoine Espirat and Etienne Sauce, Marseilles, France, "An improved filter."

1804. Henry Edward Francis De Brion, Welbeck Street, Cavendish Square, Middlesex, "An improved composition for protecting and preserving metals, such as iron, copper, and zinc, used in the construction of ships or in the protection of their sides and bottoms from oxidation and corrosion from the action of the sea water, and for protecting from corrosion all submerged substances, such as chains, anchors, cables, and every oxidable metal submerged in water or exposed to atmospheric influences."—Petitions recorded July 19, 1864.

1814. Alfred Barton, Joseph Sidebotham, and Thomas Henry Nevill, Strines, Derbyshire, "Improvements in the treatment of printed or dyed calicoes and other fabrics."—Petition recorded July 20, 1864.

1815. Edward Young, Oughtibridge, near Sheffield, Yorkshire, "Improvements in drying and calcining iron and other ores."

1821. John Whitford, Liverpool, Lancashire, "Improvements in machinery or apparatus for agitating freezing mixtures, for cooling wine and other liquors or liquids, and for manufacturing ice and ice cream."

1823. Alfred Vincent Newton, Chancery-lane, Middlesex, "Improvements in electro-telegraphic apparatus."—A communication from Royal House, New York, U.S.A.—Petitions recorded July 21, 1864.

1827. William Edward Gedge, Wellington-street, Strand, Middlesex, "An improved process or means of decongelating oils."—A communication from Eugène Bernard and Eugène Perrin, Faubourg St. Martin, Paris, France."

1828. Johannes Möller, Shaftesbury Villas, Hornsey Rise, Middlesex, "Improvements in the manufacture of marking ink."—Petition recorded July 22, 1864.

1833. Dennis Hall, Winsford, Cheshire, and August Ludwig Roosen, Manchester, Lancashire, "Improvements in the manufacture of salt."

1842. David Barker, Battersea Park, Surrey, "Improvements in the manufacture of artificial fuel."—Petitions recorded July 23, 1864.

1870. John Olive, William Olive, and Edward Partington, Woolfold, near Bury, Lancashire, "Improvements in the manufacture of paper, and in the machinery and apparatus employed therein."

1876. Jean Pierre Chambeyron, Rue de la Fidélité, Paris, France, "Certain improvements in the manufacture of steel."—Petitions recorded July 27, 1864.

1506. Peter Spence, Smedley New Road, near Manchester, and Henry Davis Pochin, Broughton Old Hall, near Manchester, "An improvement in smelting copper ore."—Petition recorded June 17, 1864.

1706. Thomas Sharp, Nashville, Tennessee, N.A., "Certain improvements in tanning hides, and in the apparatus employed therein."—Petition recorded June 17, 1864.

1875. Jeanne Pierre Chambeyron, Rue de la Fidélité, Paris, France, "Certain improvements in preventing the oxidation of iron and steel."—Petition recorded July 27, 1864.

1931. Charles Garton, Bristol, and Thomas Hill, Southampton, "Improvements in mashing apparatus."—Petition recorded August 3, 1864.

Notices to Proceed.

769. John Lightfoot, Accrington, Lancashire, "Improvements in dyeing and printing textile fabrics and yarns, and in fixing more permanently certain mordants thereon."—Petition recorded March 28, 1864.

782. Arthur Heald, Sabden Whally, Lancashire, "An improved composition for sizing yarns and threads."—Petition recorded March 29, 1864.

791. Thomas James Smith, Twickenham, Middlesex, "Improvements in the purification, distillation, rectification, evaporation, condensation, concentration, and oxygenation of spirits and spirituous liquors, and in the apparatus employed therein, and in raising and forcing the same, parts of which are applicable to the manufacture of vinegar, to the raising and forcing of liquids, to the heating, cooling, and oxygenating of beers and liquids, and to the construction of chimneys."—A communication from François Haeck, Brussels, Belgium.—Petition recorded March 30, 1864.

809. James Hicks, Hatton Garden, Middlesex, "An improved maximum mercurial thermometer."—Petition recorded April 1, 1864.

876 Joseph Strangman Richardson, Waterford, Ireland, "Improvements in preparing the carcases of pigs and other animals for curing."—Petition recorded April 7, 1864.

928. John Campbell Evans and John Calvin Thompson, East Greenwich, Kent, "Improvements in preserving the bottoms of iron and other ships and vessels."—Petition recorded April 13, 1864.

1017. George Fellows Harrington, Ryde, Isle of Wight, "Improvements in machinery or apparatus for drilling, cutting, grinding, and polishing teeth whilst in the mouth."—Petition recorded April 22, 1864.

1038. John Frederick Brinjes, Fieldgate Street, Whitechapel, Middlesex, "Improvements in apparatus for the reburning of animal charcoal."—Petition recorded April 23, 1864.

1095. Richard Archibald Brooman, Fleet Street, London, "Improvements in tanning."—A communication from Barthelemy Picard, Pateaux, France.—Petition recorded April 30, 1864.

1131. Charles James Richardson, Kensington Square, Middlesex, "Improvements in arranging steam boiler and other furnaces, in order to render them more suitable for burning petroleum and like oils."—Petition recorded May 4, 1864.

1199. Otto Sachs, Aldermanbury, London, "Improvements in the manufacture of aniline dye colours."—A communication from Richard Froehling, Berlin, Prussia.—Petition recorded May 12, 1864.

1786. John Clayton, West Bromwich, Staffordshire, "Improvements in furnaces for heating and melting iron and steel, and for other purposes."—Petition recorded July 16, 1864.

CORRESPONDENCE.

Continental Science.

Paris, August 13.

The piscicultural experiments that are being made at the Brussels Botanic Gardens under the direction of M. Schram are going on most satisfactorily. The ova were sent from the French establishment at Huningue about five years ago, and have gone through all their normal changes in the most exemplary manner. Several of the lake trout taken out of the ponds in the month of November last weighed as much as 8 lbs.—a development they hardly ever reach in their native Swiss lakes. Many of them have milted and spawned, and the fecundated ova hatched out in such large numbers that the directors were quite taken by surprise, and many of the fish were lost.

M. Nelaton has lately applied voltaic electricity to the reduction of tumours of various kinds, more especially of polypus in the nose. The platinum electrodes of a small battery are inserted in the tumour, which gradually gives way under the decomposing action of the current, coagulation taking place at the positive pole; liquefaction at the negative. The pain caused by the operation is comparatively slight, and six applications of the powerful agent were sufficient to destroy a polypus that had resisted all endeavours to remove it.

M. Kaiser, of Leipzig, has discovered that the modification of iodide of silver, which is insensitive to light, may be transformed into the sensitive iodide by being submitted to the vapour of benzol. He says that the benzol vapour acts by developing ozone in the air, in which it is suspended, having found that an atmosphere ozonised by electricity has precisely the same action. This idea is easily carried out, and would repay a few experiments on the part of some of your photographic readers. Every one has remarked that on days when the atmosphere is full of ozone, the collodion plate is always more sensitive than on other occasions; but as on such days the light is generally of the most brilliant character, it is somewhat difficult to distinguish between the *post hoc* and the *propter hoc.* M. Kaiser's experiments with benzol vapour seem to confirm a suspicion entertained by many photographers that the wet collodion plate is more sensitive than any other from containing a small quantity of ozonised ether on its surface, and not because its pores are more open in the wet state than when dry.

M. Pavesi, of Mortara, has lately been experimenting on the vesicating properties of an alcoholic tincture of the *fresh* leaves, stalks, and flowers of the common buttercup. Every one knows that this very neglected plant contains an acrid juice, but I am not aware that it has ever been utilised up to the present time. The tincture preserves its epispastic qualities for a long time, and is much cheaper, of course, than cantharides, and besides has no action on the urinary organs. A weak solution forms an excellent rubefacient.

Several of our scientific journals here, whose editors ought to know better, have been repeating the ridiculous story concerning the great cheapness of petroleum as a fuel for steam vessels as compared with coal. You will remember that your leading journal, the great Jupiter Tonans of Printing House Square, swallowed this story whole, and published a leader on the subject, which made that organ the laughing-stock of all the scientific men in England. The whole thing is so apparently absurd that it is hardly worth while to refute it. Granting that from experiments made by the American Commissioners appointed to inquire into the matter that the heating power of a pound of petroleum is equal to twice that of a pound of coal (which I doubt), it must be remembered that the former fuel is, at the lowest calculation, eighteen to twenty times as dear as the latter. When petroleum is sold at only double the price of coal it will be time to talk of using it as fuel. But even then a ton of petroleum would take up twice the room of a ton of coal, to say nothing of the danger of employing the unrefined oil for such a purpose. However, it is not likely that petroleum will ever be cheaper than it is at present; so we may leave the finders of the mare's nest to gloat over their prize. It is, however, pitiful to see journals of eminence gravely discussing a question which a glance at a price current would at once decide.

Phillips' Translation of the Pharmacopœia.

To the Editor of the Chemical News.

Sir,—I do not doubt that the law of copyright would forbid the sale of a work "on the British Pharmacopœia of the same character as Mr. Phillips' Translations of former London Pharmacopœis," at the absence of which you express a kindly surprise in the last number of your journal.

To import the entire text of a book recently published into another work without the consent of the owners of the first, and to publish this with remarks, a plan which is the very basis of Phillips' Translations, as a separate book, is, to my mind, unjustifiable; whilst to apply to the Medical Council for such consent would, of course, be futile, since every sale of a copy of such a book would prevent the sale of a copy of the British Pharmacopœia; whilst to publish the remarks without the text would not only be a wide departure from the distinctive character of Phillips' Translations, but would prove to be, from its inevitable incompleteness, but of secondary value to the student and pharmaceutist, and would probably result in the loss both of time and money had such a work been published.

Still, a small book containing a brief description of the officinal substances, and concise notes on the preparations of the British Pharmacopœia, with the requisite tables as an appendix, would be likely to be useful, and therefore saleable, were it not that custom, as I am informed, still sanctions the use of the preparations of the London Pharmacopœia of 1851; whilst rumour attributes to the Medical Council an intention to follow the example of the London College in 1788, and issue an emended edition of the British Pharmacopœia. Few persons competent to form an opinion would dissent from the wisdom and expediency of such a course, but until it is authoritatively known whether the Medical Council intend to adhere to the present, or to issue an amended edition of their Pharmacopœia, it would be idle to devote much time or expend money on a book supplementary to the present edition of the British Pharmacopœia. I am, &c.

The Editor of "Phillips' Translation of the London Pharmacopœia," 1851.

16, Park Terrace, Highbury, N., August 15.

[In the opinion of eminent lawyers it is very doubtful whether a copyright can exist in a book like the Pharmacopœia, which is binding on a section of the community. In any case there can be no difficulty in evading the law, as is done when an Act of Parliament is published with notes and forms.—Ed. *C. N.*]

On Relations Among the Equivalents.

To the Editor of the Chemical News.

Sir,—In addition to the facts stated in my late communication, may I be permitted to observe that if the elements are arranged in the order of their equivalents, calling hydrogen 1, lithium 2, glucinum 3, boron 4, and so on (a separate number being attached to each element having a distinct equivalent of its own, and where two elements happen to have the same equivalent, both being designated by the same number), it will be observed that elements having consecutive numbers frequently either belong to the same group or occupy similar positions in different groups, as in the following examples:—

		No.		No.		No.		No.		No.
Group *a*. . . .	N	6	P	13	As	26	Sb	40	Bi	54
" *b*. . . .	O	7	S	14	Se	27	Te	42	Os	50
" *c*. . . .	Fl	8	Cl	15	Br	28	I	41	—	—
" *d*. . . .	Na	9	K	16	Rb	29	Cs	43	Tl	52
" *e*. . . .	Mg	10	Ca	17	Sr	30	Ba	44	Pb	53

Here the difference between the number of the lowest member of a group and that immediately above it is 7; in other words, the eighth element starting from a given one is a kind of repetition of the first, like the eighth note of an octave in music. The differences between the numbers of the other members of a group are frequently twice as great; thus in the nitrogen group, between N and P there are 7 elements; between P and As, 13; between As and Sb, 14; and between Sb and Bi, 14.

In conclusion, I may remark that just as we have several examples of the apparent existence of triads, the extremities of which are known, whilst their centres are wanting (such as the metals of the platinum group, which may be conceived to be the extremities of three distinct triads, and perhaps also silver and gold may be related to each other in this manner), so we may look upon certain of the elements, *e.g.*, Mn, Fe, Co, Ni, and Cu, as the centres of triads, the extremes of which are at present unknown, or, perhaps, in some instances only unrecognised.

I am, &c.

John A. R. Newlands, F.C.S.

Laboratory, 19, Great St. Helens, E.C., August 8.

Equivalent of Indium.

To the Editor of the Chemical News.

Sir,—In reply to "Inquirer," who asks me to give him some idea of the equivalent of indium, I am afraid that our knowledge of this metal is too imperfect to enable us to give a satisfactory answer to such a question.

Professor Roscoe has stated (Chemical News, June 25, 1864), that indium "in its chemical relations resembles zinc, with which it is associated in nature," and taking this statement as the best existing basis on which to build our notions regarding its equivalent, we should expect to find that the atomic weight of indium bears some simple relation to those of the zinc group, including under that term magnesium, zinc, cadmium, and, perhaps, mercury. The equivalent of indium, then, may prove to be identical, or nearly so, with those of zinc or cadmium. I leave magnesium out of the question, as it is not likely that indium, from its known properties, has an equivalent lower than 50. It is also just possible that indium may occupy a position in the zinc group similar to that of thallium among the alkali metals, in which case the equivalent of indium would be 182, or thereabouts.

I am, &c. John A. R. Newlands, F.C.S.

Laboratory, 19, Great St. Helens, E.C., August 15.

Numerical Relations of Equivalents.

To the Editor of the Chemical News.

Sir,—Few would call chemistry a mathematical science; and, such being the case, I appeal against its being treated mathematically, as it was by Mr. Newlands in your impression of the 30th ult.

Mr. Newlands there gave a table constructed for the purpose of disproving that "the atomic weights are multiples of eight;" but in so doing he deals with a statement which no one would for a moment make, mathematically speaking.

My assertion was that the atomic weights are, with few exceptions, either exactly or very nearly multiples of eight, and I would submit that it is too much to require that if the atomic weights are approximately multiples of eight, therefore any differences between them must be likewise multiples of eight.

Granting necessarily some amount of latitude (for atomic weights being merely results of experiment, and not mathematical, are therefore subject to error), it is easy to see that the difference between two atomic weights which are both close approximations to a multiple of eight may be very large, owing to divergence in opposite directions—*e.g.*, lithium and glucinum both differ from eight by one, but in different directions, and therefore the difference between them is two; the same may be said of iodine (127), and tellurium (129), each differing from (8 × 16 =) 128 by one, yet from one another by two. As a strong point in favour of this law, I would point to the list of atomic weights, fifteen in number, placed at the bottom of my former note, which are exactly multiples of eight.

In conclusion, I would state that the atomic weights which I have employed are those given in Professor Williamson's paper in the *Journal* of the Chemical Society for June last. I am, &c. Studiosus.

MISCELLANEOUS.

Trial for Manslaughter.—The assistant of Messrs. Clay and Abrahams, of Liverpool, who some time ago dispensed strychnine for James's powder, was tried for manslaughter last week and acquitted. It was stated in evidence that the strychnine was kept powdered for convenience in dispensing.

Poisoning by Calabar Beans(?)—The newspapers contain an account of the poisoning of seventy children at Liverpool from eating calabar beans. It is hardly likely that the poison was calabar bean; it is more probable that what the children ate were Jatropha nuts; and it will be remembered that a similar case happened with thirty boys only a short time ago.

A Colourless Varnish.—At the time the process of varnish-making by Luning was laid before the Society of Arts, Mr. Field put in a claim, when both the processes and products were found to answer the intended purpose, and the claimants were awarded twenty guineas each. Mr. Field describes his process as follows:—Six ounces of shellac, coarsely powdered, are to be dissolved by gentle heat in a pint of spirits of wine; to this is to be added a bleaching liquor made by dissolving carbonate of potash, and then impregnating it with chlorine gas till the solution becomes slightly coloured. Of this bleaching liquor add one or two ounces to the spirituous solution of lac, and stir the whole well together. Effervescence takes place. When this ceases add more of the bleaching liquor, and thus proceed till the colour of the mixture has become pale. A second bleaching liquor is now to be added, made by diluting muriatic acid with thrice its bulk of water, and dropping into it pulverised red lead till the last added portions do not become white. Of this acid bleaching liquor small quantities at a time are to be added to the half-bleached lac solution, allowing the effervescence which takes place on each addition to cease before a fresh portion is poured in. This is to be continued until the lac, now white, separates from the liquor. The supernatant fluid is now to be poured away, the lac well washed in repeated waters, and finally wrung as dry as possible in a cloth. The lac obtained by the foregoing process is to be dissolved in a pint of alcohol, more or less, according to the required strength of the varnish; and, after standing for some time in a gentle heat, the clear liquor—which is the varnish—is to be poured off from the sediment. When the processes of Luning and Field came before the Society of Arts, the Editor of the *Franklin Journal* (Philadelphia) made known the process of Dr. Hare, in which he stated that "all the objects sought for were perfectly attained, and left nothing to desire, save on the score of economy." The following was Dr. Hare's process:—Dissolve in an iron kettle one part of pearlash in about eight parts of water, add one part of seed or shellac, and beat the whole to ebullition. When the lac is dissolved, cool the solution, and impregnate it with chlorine till the lac is all precipitated. The precipitate is white, but its colour is deepened by washing and consolidation. Dissolve in alcohol. Lac bleached by this process yields a varnish as free from colour as any copal.—*British Journal of Photography.*

ANSWERS TO CORRESPONDENTS.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

We have to acknowledge with thanks the receipt of the Report, for 1863, of the Commissioner of Patents for the United States, with two volumes of patents and drawings, liberally forwarded by the Government of the United States.

A G.—Precipitate it in the metallic state by placing a strip of copper in the solution. The precipitate will be pure silver.

A Student should write to Mr. H. Cole at the Museum, South Kensington.

TABLE OF SYMBOLS, ATOMIC WEIGHTS, &c.

By M. A. Wurtz.

Referred to in Lectures I. and II.

Elements.	Symbols of atomic weights.	New atomic weights.	Atomic weights of Berzelius.	Atomic weights of Gerhardt.	Symbols of equivalents.	Equivalent weights.
Hydrogen	H	1	1	1	H	1
Oxygen	*O*[*]	16	16	16	O	8
Nitrogen	N	14	14·02	14	N	14
Chlorine	Cl	35·5	35·52	35·5	Cl	35·5
Bromine	Br	80	80·09	80	Br	80
Iodine	I	127	127·08	127	I	127
Fluorine	Fl	19	18·70	19	Fl	19
Sulphur	*S*	32	32·17	32	S	16
Selenium	*Se*	79·5	79·37	79·5	Se	39·7
Tellurium	*Te*	129	128·48	129	Te	64
Phosphorus	P	31	31·41	31	P	31
Arsenic	As	75	75·22	75	As	75
Carbon	*C*	12	12·04	12	C	6
Boron †	Bo	11	21·82, of which the ½ = 10·91	11	Bo	10·9
Silicium	*Si*	28	44·51, of which the ⅔ = 29·66	„	Si	14
Zirconium ‡	*Zr*	89·6	67·26, of which the $\frac{4}{3}$ = 89·6	„	Zr	44·8
Potassium	K	39·1	78·47	39	K	39
Sodium	Na	23	46·43	23	Na	23
Lithium	Li	7	13·08	7	Li	7
Silver	Ag	108	216·29	108	Ag	108
Barium	*Ba*	137	137·06	68·5	Ba	68·5
Strontium	*Sr*	87·5	87·48	43·75	Sr	43·8
Calcium	*Ca*	40	40·32	20	Ca	20
Magnesium	*Mg*	12	25·34	12	Mg	12
Aluminium	*Al*	27	27·39	13·75	Al	13·7
Manganese	*Mn*	55	55·23	27·5	Mn	27·5
Chromium	*Cr*	53·5	52·70	26·25	Cr	26·7
Uranium	*U*	120	118·88	60	U	60
Iron	*Fe*	56	56·17	28	Fe	28
Cobalt	*Co*	59	59·07	29·5	Co	29·5
Nickel	*Ni*	59	59·19	29·5	Ni	29·5
Zinc	*Zn*	65·2	65·16	32·6	Zn	32·6
Cadmium	*Cd*	112	111·66	56	Cd	56
Copper	*Cu*	63·5	63·39	31·75	Cu	31·7
Lead	*Pb*	207	207·47	103·5	Pb	103·5
Bismuth	Bi	210	213·20	210	Bi	210
Tin	*Sn*	118	117·83	56	Sn	59
Titanium	*Ti*	50	48·3	137·32	Ti	25
Tungsten	*Wo*	184	190·44	92	Wo	92
Molybdenum	*Mo*	96	95·53	48	Mo	48
Vanadium	*Va*	137·2	137·32	48	Vd	68·5
Antimony	Sb	122	129·24	122	Sb	122
Mercury	*Hg*	200	200·52	100	Hg	100
Rhodium	*Rh*	104·4	104·48	„ „	Rh	52
Palladium	*Pd*	106·6	106·64	„ „	Pd	53·3
Platinum	*Pt*	197	197·44	98·5	Pt	98·7
Iridium	*Ir*	198	197·44	98·5	Ir	99
Ruthenium	*Ru*	104·4	„ „		Ru	52·2
Osmium	*Os*	199·2	199·13		Os	99·5
Gold	Au	197	196·98		Au	197

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[*] Italics are used instead of barred letters for the double equivalents.

† The vapour densities of the chlorides of boron and silicium oblige us to represent them as $BoCl_3$ and $SiCl_4$; boric and silicic acid will therefore be Bo_2O_3 and SiO_2. We thus halve the atomic weight Berzelius attributed to boron, and take two-thirds of that he adopted for silicium.

‡ Berzelius represented zirconia as Zr_2O_3. In adopting the formula ZrO_2 we increase the atomic weight of zirconium to $\frac{4}{3}$.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on Oxygen, by Dr. G. Meissner.

(Continued from page 74.)

The greater part of the gas evolved in the process last described is, in fact, only ordinary oxygen, and, as was said, but a very weak solution of oxygenated water is obtained. A much stronger solution may be procured by decomposing peroxide of barium with carbonic acid, simply passing the acid through water mixed with the peroxide. The greater part of the oxygen set free in this way combines with the water, and we obtain in a short time a very concentrated solution—so concentrated, in fact, that it will begin to decompose on exposure to light.

The most delicate test for peroxide of hydrogen the author found to be that given by Schönbein—viz., iodide of potassium assisted by protosulphate of iron. By these reagents Schönbein was able to recognise distinctly the presence of $\frac{1}{50.000}$th in a solution. Very dilute solutions both of the iodide of potassium and the protosulphate of iron must be employed.

Meissner, like Schönbein, believes that a perfectly neutral solution of pure peroxide of hydrogen alone will not decompose iodide of potassium, but with a "disposing" agent like the protosulphate of iron the reaction takes place immediately. Certain precautions are necessary in applying the test. The iodide of potassium with a little starch must first be mixed with the solution of the peroxide, and the solution of protosulphate added drop by drop to the mixture, waiting a short time between the addition of the drops for the blue colour to form. If too much protosulphate of iron be added, no iodine is set free. The author accounts for this by supposing that the first action which takes place is the oxidation of the protosulphate to the state of insoluble basic sulphate, and the action proceeding involves the iodide of potassium; but if too much sulphate of iron is added the whole of the oxygen liberated is used up in converting protosulphate into basic sulphate.

In continuation of his notice of the tests for HO_2, the author mentions the fact first observed by Schönbein—that the presence of a small quantity of acid—sulphuric, nitric, or hydrochloric—in the solution prevents the decomposition of iodide of potassium (for some time, at all events), most probably by increasing the stability of the compound. But he adds that if the acid be introduced into a mixture—the iodide with a neutral solution of HO_2—a decomposition takes place immediately.

Meissner proceeds to show that a very feebly acidulated solution of iodide of potassium, which contains no trace of iodate, gradually decomposes—a fact previously noticed by Baumert and Andrews; and he specially cautions the experimenter against the use of common commercial iodide, which usually contains iodate, or even pure iodide which has been kept in the laboratory where ozone is evolved; for he has found that in the latter case the crystals, without losing their whiteness, become partially converted into iodate. He then remarks on the difference between the action of acids and the protosulphate of iron on the mixed solutions of HO_2 and iodide of potassium. The former, he says, decompose the iodide and induce the decomposition of the HO_2; the latter, he states, decomposes the HO_2, and induces the decomposition of the iodide.

The decomposition of iodide of potassium with HO_2 on the addition of an acid is by no means so sensitive a test as the reaction with protosulphate of iron, and is, besides, open to the objection that it may only show the presence of iodate of potash.

Meissner next refers to Schönbein's discovery of the presence of antozone in the fluor spar found at Welsendorf. He repeated and confirmed all Schönbein's experiments with this curious substance. It was found that when a small quantity of the spar was rubbed in a porcelain mortar with just sufficient water to cover it, the water, when filtered, gave all the reactions of a solution of HO_2. The behaviour of the water with the iodide of potassium differs somewhat, according as it is rubbed for a long or a short time with the spar. If rubbed but for a short time, the addition of the iodide of potassium results in the instantaneous separation of a very small amount of iodine; when the rubbing is continued for some time, however, the mixture of water and iodide will remain colourless for at least a minute, but the addition of solution of protosulphate of iron will immediately cause the decomposition of the iodide. The author agrees with Schönbein in supposing that in the former case the water contains free antozone simply dissolved, while by longer rubbing it becomes perfectly combined. This view is confirmed by the fact that the water which has been rubbed but for a short time and decomposes the iodide, loses its power to do so after a short boiling, which suffices to drive off free antozone, but does not destroy peroxide of hydrogen.

We need not follow the author through the other experiments by which he satisfied himself that the reactions of the fluor spar water were really those of peroxide of hydrogen, of which he entertains no doubt. He has nothing to say on the state in which antozone exists in the Welsendorf spar, nor does he explain how it is developed by the rubbing, but he states that he has experimented with a variety of other spars and minerals, some of which evolve a peculiar smell when rubbed, but with no one has he been able to produce the smallest trace of antozone.

The next so-called antozonide examined was oxidised oil of turpentine. This the author found to present the same reactions as the water rubbed with Welsendorf spar, and hence he concludes that this also contains peroxide of hydrogen, and also a "disposing" agent which, like protosulphate of iron, induces the decomposition of iodide of potassium.

(To be continued.)

On the Properties of Silicic Acid and other analogous Colloidal Substances,[*] *by* Thomas Graham, *F.R.S.*

(PRELIMINARY NOTICE.)

The prevalent notions respecting solubility have been derived chiefly from observations on crystalline salts, and are very imperfectly applicable to the class of colloidal substances. Hydrated silicic acid, for instance, when in the soluble condition, is, properly speaking, a liquid body, like alcohol, miscible with water in all proportions. We have no degrees of solubility to speak of with respect to silicic acid, like the degrees of solubility of a salt, unless it be with reference to silicic acid in the gelatinous condition, which is usually looked upon as destitute of solubility. The jelly of silicic acid may be more or less rich in combined water, as it is first prepared, and it appears to be soluble in proportion to the extent of its hydration. A jelly containing 1 per cent. of silicic acid gives with cold water a solution containing about 1 of silicic acid in 5000 water; a jelly containing 5 per cent. of silicic acid gives a solution containing about 1 part of acid in 10,000 water. A less hydrated jelly than the last mentioned is still less soluble; and finally, when the jelly is rendered anhydrous, it gives gummy-looking white masses, which appear to be absolutely insoluble, like the light dusty silicic acid obtained by drying a jelly charged with salts in the ordinary analysis of a silicate.

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[*] Abstracted from the *Proceedings* of the Royal Society, with additions by the author.

The liquidity of silicic acid is only effected by a change, which is permanent (namely, coagulation or pectisation), by which the acid is converted into the gelatinous or pectous form, and loses its miscibility with water. The liquidity is permanent in proportion to the degree of dilution of silicic acid, and appears to be favoured by a low temperature. It is opposed, on the contrary, by concentration, and by elevation of temperature. A liquid silicic acid of 10 or 12 per cent. pectises spontaneously in a few hours at the ordinary temperature, and immediately when heated. A liquid of 5 per cent. may be preserved for five or six days; a liquid of 2 per for two or three months; and a liquid of 1 per cent. has not pectised after two years. Dilute solutions of 0·1 per cent. or less are no doubt practically unalterable by time, and hence the possibility of soluble silicic acid existing in nature. I may add, however, that no solution, weak or strong, of silicic acid in water has shown any disposition to deposit *crystals*, but always appears on drying as a colloidal glassy hyalite. The formation of quartz crystals at a low temperature, of so frequent occurrence in nature, remains still a mystery. I can only imagine that such crystals are formed at an inconceivably slow rate, and from solutions of silicic acid which are extremely dilute. Dilution no doubt weakens the colloidal character of substances, and may, therefore, allow their crystallising tendency to gain ground and develope itself, particularly where the crystal once formed is completely insoluble, as with quartz.

The pectisation of liquid silicic acid is expedited by contact with solid matter in the form of powder. By contact with powdered graphite, which is chemically inactive, the pectisation of a 5 per cent. silicic acid is brought about in an hour or two, and that of a 2 per cent. silicic acid in two days. A rise of temperature of 1°·1 C. was observed during the formation of the 5 per cent. jelly.

The ultimate pectisation of silicic acid is preceded by a gradual thickening in the liquid itself. The flow of liquid colloids through a capillary tube is always slow compared with the flow of crystalloid solutions, so that a liquid-transpiration-tube may be employed as a colloidoscope. With a colloidal liquid alterable in viscosity, such as silicic acid, the increased resistance to passage through the colloidoscope is obvious from day to day. Just before gelatinising silicic acid flows like an oil.

A dominating quality of colloids is the tendency of their particles to adhere, aggregate, and contract. This idio-attraction is obvious in the gradual thickening of the liquid, and when it advances leads to pectisation. In the jelly itself, the specific contraction in question, or *synæresis*, still proceeds, causing separation of water, with the division into a clot and serum; and ending in the production of a hard stony mass, of vitreous structure, which may be anhydrous, or nearly so, when the water is allowed to escape by evaporation. The intense synæresis of isinglass dried in a glass dish over sulphuric acid *in vacuo* enables the contracting gelatin to tear up the surface of the glass. Glass itself is a colloid, and the adhesion of colloid to colloid appears to be more powerful than that of colloid to crystalloid. The gelatin, when dried in the manner described upon plates of calcspar and mica, did not adhere to the crystalline surface, but detached itself on drying. Polished plates of glass must not be left in contact, as is well known, owing to the risk of permanent adhesion between their surfaces. The adhesion of broken masses of glacial phosphoric acid to each other is an old illustration of colloidal synæresis.

Bearing in mind that the colloidal phasis of matter is the result of a peculiar attraction and aggregation of molecules, properties never entirely absent from matter, but greatly more developed in some substances than in others, it is not surprising that colloidal characters spread on both sides into the liquid and solid conditions. These characters appear in the viscidity of liquids, and in the softness and adhesiveness of certain crystalline substances. Metaphosphate of soda, after fusion by heat, is a true glass or colloid; but when this glass is maintained for a few minutes at a temperature some degrees under its point of fusion, the glass assumes a crystalline structure without losing its transparency. Notwithstanding this change, the low diffusibility of the salt is preserved, with other characters of a colloid. Water in the form of ice has already been represented as a similar intermediate form, both colloid and crystalline, and in the first character adhesive and capable of reunion or "regelation."

It is unnecessary to return here to the fact of the ready pectisation of liquid silicic acid by alkaline salts, including some of very sparing solubility, such as carbonate of lime, beyond stating that the presence of carbonate of lime in water was observed to be incompatible with the co-existence of soluble silicic acid, till the proportion of the latter was reduced to nearly 1 in 10,000 water.

Certain liquid substances differ from the salts in exercising little or no pectising influence upon liquid silicic acid. But, on the other hand, none of the liquids now referred to appear to conduce to the preservation of the fluidity of the colloid, at least not more than the addition of water would do. Among these inactive diluents of silicic acid are found hydrochloric, nitric, acetic, and tartaric acid, syrup of sugar, glycerine, and alcohol. But all the liquid substances named, and many others appear to possess an important relation to silicic acid, of a very different nature from the pectising action of salts. They are capable of displacing the combined water of the silicic acid hydrate, whether that hydrate is in the liquid or gelatinous condition, and give new substitution products.

A liquid compound of *alcohol* and silicic acid is obtained by adding alcohol to aqueous silicic acid, and then employing proper means to withdraw the water from the mixture. For that purpose the mixture contained in a cup may be placed over dry carbonate of potash or quicklime, within the receiver of an air-pump. Or a dialysing bag of parchment paper containing the mixed alcohol and silicic acid may be suspended in a jar of alcohol: the water diffuses away, leaving in the bag a liquid composed of alcohol and silicic acid only. A point to be attended to is, that the silicic acid should never be allowed to form more than 1 per cent. of the alcoholic solution, otherwise it may gelatinise during the experiment. If I may be allowed to distinguish the liquid and gelatinous hydrates of silicic acid by the irregularly-formed terms of *hydrosol* and *hydrogel* of silicic acid, the two corresponding alcoholic bodies now introduced may be named the alcosol and alcogel of silicic acid.

The *alcosol* of silicic acid, containing 1 per cent. of the latter, is a colourless liquid, not precipitated by water or salts, nor by contact with insoluble powders, probably from the small proportion of silicic acid present in solution. It may be boiled and evaporated without change, but is gelatinised by a slight concentration. The alcohol is retained less strongly in the alcosol of silicic acid than water is in the hydrosol, but with the same varying force, a small portion of the alcohol being held so strongly as to char when the resulting jelly is rapidly distilled at a high temperature. Not a trace of silicic ether is found in any compound of this class. The jelly burns readily in the air, leaving the whole silicic acid in the form of a white ash.

The *alcogel*, or solid compound, is readily prepared by placing masses of gelatinous silicic acid, containing 8 or 10 per cent. of the dry acid, in absolute alcohol, and changing the latter repeatedly till the water of the hydrogel is fully replaced by alcohol. The alcogel is generally slightly opalescent, and is similar in aspect to the hydrogel, preserving very nearly its original bulk. The following is the composition of an alcogel carefully prepared from a hydrogel which contained 9·35 per cent. of silicic acid :—

Alcohol	88·13
Water	0·23
Silicic acid	11·64
	100·00

Placed in water, the alcogel is gradually decomposed—alcohol diffusing out and water entering instead, so that a hydrogel is reproduced.

Further, the alcogel may be made the starting point in the formation of a great variety of other substitution jellies of analogous constitution, the only condition required appearing to be that the new liquid and alcohol should be intermiscible, that is, interdiffusible bodies. Compounds of ether, benzole, and bisulphide of carbon have thus been produced. Again, from *etherogel* another series of silicic acid jellies may be derived, containing fluids soluble in ether, such as the fixed oils.

The preparation of the *glycerine* compound of silicic acid is facilitated by the comparative fixity of that liquid. When hydrated silicic acid is first steeped in glycerine, and then boiled in the same liquid, water distils over, without any change in the appearance of the jelly, except that when formerly opalescent it becomes now entirely colourless, and ceases to be visible when covered by the liquid. But a portion of the silicic acid is dissolved, and a *glycerosol* is produced at the same time as the glycerine jelly. A glycerogel prepared from a hydrate containing 9·35 per cent. of silicic acid was found by a combustion analysis to be composed of—

Glycerine	87·44
Water	3·78
Silicic acid	8·95
	100·17

The glycerogel has somewhat less bulk than the original hydrogel. When a glycerine jelly is distilled by heat it does not fuse, but the whole of the glycerine comes over, with a slight amount of decomposition towards the end of the process.

The compound of sulphuric acid, *sulphagel*, is also interesting from the facility of its formation, and the complete manner in which the water of the original hydrogel is removed. A mass of hydrated silicic acid may be preserved unbroken if it is first placed in sulphuric acid diluted with two or three volumes of water, and then transferred gradually to stronger acids, till at last it is placed in concentrated oil of vitriol. The sulphagel sinks in the latter fluid, and may be distilled with an excess of it for hours without losing its transparency or gelatinous character. It is always somewhat less in bulk than the primary hydrogel, but not more, to the eye, than one-fifth or one-sixth part of the original volume. This sulphagel is transparent and colourless. When a sulphagel is heated strongly in an open vessel, the last portions of the monohydrated sulphuric acid in combination are found to require a higher temperature for their expulsion than the boiling point of the acid. The whole silicic acid remains behind, forming a white, opaque, porous mass, like pumice. A sulphagel placed in water is soon decomposed, and the original hydrogel reproduced. No permanent compound of sulphuric and silicic acids, of the nature of a salt, appears to be formed in any circumstances. A sulphagel placed in alcohol gives ultimately a pure alcogel. Similar jellies of silicic acid may readily be formed with the monohydrates of nitric, acetic, and formic acids, and are all perfectly transparent.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

On Digitaline, by M. Lefort.

The following account of the two foreign digitalines met with in commerce will be of interest to English readers, since this country is, we believe, entirely supplied with the article from Continental sources :—

1. **German or Soluble Digitaline.**— This is said by the author to be made by Merck, of Darmstadt. It is of a yellowish white colour, neutral to test paper, completely and readily soluble in water and alcohol. It is, on the contrary, but slightly soluble in ether, sulphide of carbon, and benzole. Tannin completely precipitates it from an aqueous solution. In one particular it will be seen, that of solubility in water, this article differs essentially from that described in the British Pharmacopœia.

When the powder is dropped into hydrochloric acid it immediately dissolves, forming a yellow solution, which gradually turns brown and finally becomes green. The green colour, however, is less bright than that given by the insoluble digitaline to be presently described, and the solution also remains transparent longer.

As the green colour is developed the solution becomes turbid, and emits an odour resembling that of powdered digitalis or the tincture, and deposits a brown substance, which seems to be a compound of digitaline or of one of the principles accompanying with hydrochloric acid.

When exposed to the vapour of hydrochloric acid this soluble digitaline turns rapidly brown, but exhibits no green colour.

Examined by a microscope with a high power the powder is seen to consist of small semi-transparent fragments, sometimes presenting sharp edges, but of no definite crystalline form. An alcoholic solution evaporates spontaneously to a clear varnish, and no trace of crystallisation can be observed.

2. **French, or Insoluble Digitaline.**—The colour of French digitaline varies from a yellowish white to a bright yellow. It is but very slightly soluble in cold water, a litre only dissolving about 0·50 gramme; it is very soluble in alcohol. Sulphuric ether, sulphide of carbon, and benzole dissolve a small quantity; tannin precipitates it from a saturated aqueous solution.

The powder dropped into hydrochloric acid gives a yellow solution which, in a few minutes, passes from a bright to a deep green, according to the quantity of digitaline employed; but as the green tint is produced, a deep green-coloured substance is deposited, and a smell of digitalis is evolved.

When exposed to the vapour of hydrochloric acid it is first coloured yellow, then brown, and afterwards green, the characteristic smell of digitalis becoming very apparent. The green powder (like the fresh powder of foxglove leaves) becomes a partially decolorised by exposure to sunlight, but the colour can be restored by another exposure to the vapours of the acid.

This last reaction suffices to distinguish between soluble and insoluble digitaline, and the author considers it sufficient to prove the presence of the latter.

An alcoholic solution of French digitaline (Menier's), left to evaporate spontaneously, and then examined by the microscope, showed a multitude of small spots, sometimes round and sometimes oval, which gave to the residue the cellular aspect of organised structure. This appearance the author considered to support the opinion of Homolle, who supposed that insoluble digitaline was never a single and constant product; and he, in fact, determined that French digitaline contained some volatile matter which communicated its characteristic odour.

The whole of M. Lefort's experiments showed that French and German digitaline differ considerably in their chemical and physical properties, and he is disposed to infer that as great differences may be found in their therapeutical properties.

With regard to the separation of digitaline by means of dialysis, the author found that a simple solution of the substance quickly dialysed, and the digitaline could easily be found in the diffusate. But when a mixture with animal and vegetable substances was placed on the dialyser, the deposit obtained on evaporating the diffusate gave but indistinctly the characteristic reactions of digitaline. Among these characters the most conclusive appear to be the bitterness of taste, the green coloration of liquid hydrochloric acid, and the development of the peculiar odour of digitalis on exposure to the vapour of hydrochloric acid.

[It may interest some of our readers to know that the volume of Gmelin's "Chemistry" just issued contains an excellent account of digitalis, and the various processes for obtaining it.—Ed. C. N.]

PROCEEDINGS OF SOCIETIES.

CANTOR LECTURES.

"*On Chemistry Applied to the Arts.*" *By* Dr. F. Crace Calvert, *F.R.S., F.C.S.*

Lecture V.*

Delivered on Thursday Evening, May 5, 1864.

Bile, its properties. *Blood*, its composition, and application in the refining of sugar and manufacture of albumen. *Albumen*, its application to calico-printing and photography. *Milk*, its composition, properties, falsification, and preservation. *Urine*, its uses. A few words on putrefaction.

In this lecture we shall examine the composition of the various liquids secreted in the human body and in those of animals, and the uses to which these fluids are applied in arts and manufactures.

Bile.—The composition and appearance of bile vary greatly in different animals. Usually it is a yellow, green, or brown, thick fluid, with a marked alkaline reaction, and containing about 14 per cent. of solid matter, the most important constituents of which are, in human bile, mucus, two colouring matters, one yellow (*cholepyrrhine*) the other green (*biliverdine*), sugar, albumen, two organic acids (*cholic and choleic*), combined with soda, oleate and margarate of soda, a non-saponifiable fatty matter (*cholesterine*), and several mineral salts. The two most interesting substances in bile are choleic acid and cholesterine, which when produced in undue proportion, give rise to those calculi, the passage of which through the biliary duct is so dangerous and painful. One of the most valuable papers published of late is that of Mr. G. Kemp, in the *Transactions* of the Royal Society, on the conversion of the hepatic bile into cestic,—thus he has shown that as the former is secreted by the liver, and arrives by the biliary duct into the gall bladder, it is there converted into cestic bile by means of a special fermentation induced by a mucus secreted in the walls of the gall bladder. It is believed by most physiologists that the principal function of bile is to neutralise the acid fluids resulting from digestion in the stomach, as they enter the small intestines, rendering them better adapted for their sojourn there, and also facilitating their fermentation, one of the most important phenomena of digestion. The employment of bile as a scouring agent has much diminished of late years owing to the substitution for it of benzine and Sherwood spirit.

Blood.—The study of this all-important fluid is most interesting, in a physiological point of view, for the twenty-seven pounds of blood (the average amount in an adult) which travels through the whole of the human frame in about three minutes, fulfils three distinct functions—viz., it carries the various elements of food, as modified by digestion, into the different parts of the body requiring them; it helps to remove from the system those substances which have fulfilled their required functions in it, and which have been rendered useless by the wear and tear of life; and it conveys through the system the heat generated by the oxidation, through respiration, of the substances which have been absorbed during digestion, as well as of those which have performed their part in the human economy, and require to be removed therefrom. It will, therefore, be easily understood that blood must be a complicated fluid; and the following table will give an idea of the truth of this assertion:—

1000 parts of blood.

130·85 of clot	Fibrine	2·95	130·85
	Globules	125·63	
	Hematosine	2·27	
869·15 of serum.	Water	790·37	869·15
	Albumen Soda	67·80	
	Phosphate of Soda Lactate of do. Carbonate of do. Chloride of Sodium ,, of Potassium Carbonate of Lime ,, of Magnesia Ammoniacal Salts Phosphate of Lime ,, of Magnesia Sulphate of Potash Fatty Acids, free or combined Cholesterine Lecithine (phosphurretted fat) Ceribrine, or nitrogenated fat	10·98	
1000·00			1000·00

It will facilitate our study of this complicated fluid if we class the various compounds existing in it under six different heads. Firstly, if blood, immediately after being drawn from an animal, is whipped with a birchrod, the ends of the twigs will have hanging from them a stringy mass, which after being well washed is grey and elastic, and is called *fibrine*. Secondly, if the blood so treated is mixed with a solution of sulphate of soda of sp. gr. 1·16, and the whole thrown on a filter, the *corpuscles* and the colouring matter called *hematosine*, will remain on the filter, and these substances, with the fibrine, form, as shown in the table, the clot of blood. Further, if the matter left on the filter is treated with concentrated acetic acid, the colouring matter is dissolved and the corpuscles are left as yellow discs. Thirdly, on boiling the fluid which passes through the filter, albumen is coagulated and can be easily separated, leaving water and a few saline substances which are easily separated by evaporating the liquid portion. Allow me now to add a few remarks on some of the substances above mentioned. Fibrine represents the fibrous or muscular part of animals, but has no direct application in manufactures. The blood corpuscles in man are ellipsoid discs, containing the colouring matter of blood. The most interesting fact connected with the latter is that it is united with a compound containing iron; and although iron does not appear to be an integral part of the colour, still its presence appears essential to the existence of the colour itself. The external part of the discs is composed of fibrine, whilst the interior contains an albuminous fluid (which differs from the albumen of the serum in the fact that it is not coagulated by heat) and which is called globuline. The relative proportion of fibrine, globuline, and hematosine, vary considerably in different individuals, according to health, age, and sex, and even during the process of digestion. When blood is examined under the microscope, large colourless globules are found to float with those just described. Dr. William Roberts, of Manchester, who has examined the corpuscles of blood, has observed that when they are dipped into a solution of magenta, they assume not only a pink colour, but that the nucleus of the disc acquires a much deeper shade. Further, that on the sides of the disc there are small projections which he calls pullulations, and which acquire a much deeper tint than the remainder of the discs when plunged into the magenta solution. Another curious fact lately observed by M. Pasteur is that if blood is kept for several weeks in a cold situation, air being excluded, the corpuscles disappear, and are replaced by myriads of beautiful red well-defined crystals. Lastly, there is a slight difference of composition between arterial and venous blood.

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* This lecture was No. VI. when the course was delivered, but the present order of publication has been adopted, as bringing the whole subject more systematically before the reader.

	Arterial.	Venous.
Carbon	50·2	55·7
Nitrogen	16·3	16·2
Hydrogen...	6·6	6·4
Oxygen	26·3	21·7
	99·4	100·0

It is strange that while blood is so extensively employed on the Continent in various branches of manufacture that in Paris 2000 tons of blood are used by sugar refiners alone, hardly any such application of this fluid is made in our own country. It appears to me that the explanation is to be found in the fact that on the Continent beasts are generally slaughtered in public abattoirs, by which means many of the refuse matters can be collected with advantage, and without being spoilt or polluted by unscrupulous persons, whilst in this country, where animals are slaughtered in innumerable private slaughter-houses, the difficulty and expense of collection, together with the absence of guarantee of quality, render the successful use of blood on a large scale impracticable. There is an additional advantage in the system of public abattoirs, which I cannot help noticing *en passant*—viz., the guarantee thereby obtained that the public food is not furnished from diseased animals. The only employment of blood in its integrity in this country is as an article of diet, and to some extent in the manufacture of prussiate of potash. The serum of blood is sometimes used in England, as well as on the Continent, as one of the substances essential in the process followed to communicate to cotton the magnificent colour called "Turkey red."

Albumen (blood).—The employment of this substance in the art of calico printing is of comparatively recent date, as it is chiefly due to the introduction of the tar colours and pigment styles into that art. To fix colours with this albumen (or that of egg) it is only necessary to dissolve in a gallon of water several pounds of albumen and gum Senegal, adding a little tar colour, such as magenta, &c., or a pigment, such as ultramarine blue; these mixtures are then printed on the cotton fabric, and the colour fixed by the coagulation of the albumen under the influence of high pressure steam. But the quantity of albumen used for this purpose has greatly decreased of late years, owing to the introduction of tannin by Mr. Charles Lowe and myself, Messrs. Roberts, Dale, and Co., and Mr. Gratrix, and also that of the arseniate of alumina by Mr. W. A. Perkin. The substitution of blood albumen for that of egg is chiefly due to Messrs. Robart, Roger, and Co., who, I believe, prepare it by separating carefully the serum of blood from the clot, adding to it a small quantity of alum to separate any colouring matter that may be mixed with it, and evaporating the water of the serum by a current of air heated to 100°, which leaves the albumen in the form of yellowish scales, freely soluble when placed again in contact with water. The most abundant source of albumen, however, is the white of egg, and, therefore, let us glance at a few facts connected with this substance, doubly important as an article of manufacture and as one of food. To give some idea of the extensive use of eggs, I may state that in Paris there are annually consumed 178,000,000 eggs, weighing 28,000,000 lbs. The composition of a hen's egg may be stated to be as follows:—

Shell	11.5
White	58.5
Yolk	30.0
	100.0

The following are the respective compositions of the yolk and white:—

Yolk.	
Water	51.47
Vitelline ...	15.76
Oleine Margarine Cholesterine	28.97
Phospho-glyceric acid	1.26
Colouring matters	1.20
Mineral salts ...	1.34
	100.000

White.	
Water	86.34
Albumen	12.50
Membrane	0.50
Phosphates, Chlorides, &c.	0.66
	100.00

An egg may be considered as consisting of four parts, the shell, membrane, white, and yolk. The shell is composed of carbonates of lime and magnesia, phosphate of lime, and oxide of iron, the whole bound together by a nitro-sulphuretted substance. The presence of sulphur in this substance, as well as in albumen, explains why eggs give off sulphuretted hydrogen when boiled. The membrane lining the shell is also a nitro-sulphuretted substance, much resembling in its composition that of horn. I have already had occasion to speak of the interesting composition of the yolk of egg, when mentioning its application in the glove manufacture, and on that occasion I drew your attention to the remarkable substance called vitelline, and to the peculiar nature of the fats contained in yolk of eggs, but more especially the phospho glyceric acid, and attributing to them the peculiar properties imparted to leather through their use. The white of egg chiefly consists, as the above table shows, of a substance called albumen, which you will remember is also found in blood, and, I may add, that it exists in the sap of all plants.

Albumen is a fluid of an alkaline reaction, soluble in water, and coagulates at 160° when undiluted, but when dissolved in water the temperature at which it coagulates is raised according to the extent of its dilution. Albumen gives a precipitate with all metallic salts, but one of the most characteristic and delicate tests for albumen in solution is bichloride of mercury or corrosive sublimate. In fact, albumen is the best antidote known to the action of this violent poison, when taken internally, as was proved by its saving the life of a most eminent chemist (Baron Thenard) in 1825. All acids, except phosphoric and acetic, precipitate albumen from its solutions, but that which separates it with the greatest nicety is nitric acid. When placed in contact with hydrochloric acid for a few hours, it assumes a very beautiful purple colour. When albumen is placed in shallow vessels, and then stored in a chamber where air at 100° is allowed to circulate, the water evaporates, and leaves the solid albumen in the form of yellowish semi-transparent scales, which, strange to say, will, if kept dry, resist putrefaction for any length of time, although in its liquid form the large amount of nitrogen it contains renders it highly putrescible. It is this solid albumen which is used by calico printers, as it is easily dissolved in water, and rendered applicable to their purposes. Albumen is often used in manufactures to clarify fluids. In some instances the albumen in solution is added to the fluid and carried to the boil, when the dissolved albumen coagulates, and in falling through the fluid carries with it mechanically the matters in suspension, when it is only necessary to decant the clarified fluid. In others it is added at natural temperature, as in the case of wines, where the tannin, alcohol, and acids are the agents which coagulate the albumen. Albumen was first applied to photography by Niepce de St. Victor, in the following form:—He mixed together intimately 10 fluid ounces of distilled water with the white of 10 fresh eggs; to this he added 200 grains of chloride of sodium or chloride of ammonium. The whole was well shaken in a bottle for about ten minutes, and then allowed to stand. All that was then required was to decant the clear liquor, and apply it to the surfaces intended to receive the photographic image. [Here the lecturer shortly described this photographic process, and alluded to the recent application of the light resulting from the combustion of magnesium wire, manufactured by Messrs. J. Mellor and Co., of Salford, showing its applicability to photography, by using this light to take photographs during the lecture, stating that the cost was only a few pence.] A great many attempts have been made to preserve eggs from decay, the most successful of which have been those of Le Maison Cormier du Mans, who covers the egg with an impermeable varnish, packing them in sawdust, so that the egg shall always rest on one end. Another process is that of immersing the eggs in lime water. Lastly, the whole of the egg has been emptied out of the shell and evaporated to a solid mass. I must not conclude the subject of the albuminous and vitelline substances without calling your attention to the following table, which will give an idea of the different albumens and vitellines which Mr. E. Fremy has succeeded in isolating and characterising:—

Eggs of Birds.

Albumen	coagulated by heat	
Eudophacine	,, ,,	All these substances are characterised by containing sulphur.
Albumen	,, acid	
Meta albumen	,, neither	
Exophacine	,, ,,	

Eggs of Fishes.

Ray	Ichthine	All these substances are characterised by containing phosphorus,
Goldfish Carp	Ichthidine	
Salmon	Icthuline and Salmonic acid	
Turtle	Eurydine	

(To be continued.)

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, May 13.

John Scott Russell, Esq., C.E., F.R.S., read a paper "*On the Mechanical Nature and Uses of Gun-cotton.*"*

Gun-cotton is a new power coming under the same category as steam and gunpowder. It is highly dangerous to those who do not possess the necessary knowledge and skill; but, like them, it enormously extends human power, and like them, the skill to use it can be rightly and certainly acquired.

I. Is gun-cotton stronger than gunpowder? The answer to this is, Yes, sixfold stronger.

By this we mean that if we take a given weight of gun-cotton, say 4 ounces, if we bore a hole 1½ inch in diameter and 3 feet deep, into hard rock or slate, in a quarry, and put 4 ounces of gun-cotton into it, it will occupy about 1 foot of its length, and the aperture being closed in the usual manner, and a matchline led from the charge to the proper distance from which to fire it; and if we next take 24 ounces of best gunpowder, bore a similar hole, and charge it similarly with gunpowder, and close it in the same way, it has been found that, on these being exploded, the 4 ounces of gun-cotton have produced greater effect, in separating the rock into pieces, than the 24 ounces of gunpowder. The answer is, therefore, that in disruptive explosion the strength of gun-cotton is sixfold that of good gunpowder.

But the disruptive or bursting power of gunpowder is not always the quality for which we value it most, nor the service we require of it. In mining rocks, in exploding shells, in blowing up fortresses, this property is what we value, and this work is what we require. But we do not want to burst our fowling-pieces, our rifles, our cannon. On the contrary, we want to use a force that shall project the projectile out of the gun without bursting the gun, without straining the gun beyond a given moderate limit, which it shall be able to endure. We want, therefore, a service from gun-cotton which shall be the contrary of destructive to, or disruptive of, the chamber in which it does the work of giving motion to the projectile.

This moderated and modified work, gun-cotton can also perform; and it is the modern discovery of General Lenk which has enabled us to moderate and modify gun-cotton to this gentler service. He discovered how to organise, arrange, and dispose mechanically of gun-cotton in such a way that it should be three times stronger than gunpowder. Accordingly one of his charges of gun-cotton, weighing 16 ounces, projected a 12-pound solid round shot with a speed of 1426 feet a second, while a charge of gunpowder of 49 ounces gave the same shot a speed of 1400 feet a second. One-third of the weight of gun-cotton exceeded, therefore, the threefold weight of gunpowder in useful effect.

II. Is gun-cotton more convenient than gunpowder? This is a larger and more various question than the former, and divides itself into various subdivisions.

It is well known to sportsmen, to soldiers, to artillerymen, that gunpowder fouls a gun. A foul residue of soot, sulphur, and potash soils the inside of the gun after every charge; the gun must, somehow, be cleaned after a discharge; if not it fires worse, recoils more, and ceases to do its best. If the gun be a breech-loading gun its mechanism is dirtied, and works less easily. Gun-cotton deposits no residue, leaves the gun clean and clear, and the utmost it does is to leave a gentle dew of clear water on the inside of the bore, this water being the condensed steam which forms one of the products of its decomposition. Gun-cotton is, therefore, superior to gunpowder in not fouling the gun, a result favourable both to quicker and more accurate firing.

It is further a matter of no slight convenience that gun-cotton makes no smoke. In mines the smoke of gunpowder makes the air unbreathable, and for some time after explosion the miners cannot return to their work. In boring the great tunnel of Mont Cenis through the Alps, the delay from smoke of powder alone will postpone the opening of the line for many months. After a properly-conducted explosion of gun-cotton the workmen may proceed in their work at once without inconvenience.

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* For the Chemical History of Gun-cotton, see Mr. Abel's discourse Chemical News, vol. ix., p. 254.

In casemates of fortresses gunpowder fills the casemates with foul smoke, and the men speedily sink under the exertion of quick firing. By using gun-cotton it was ascertained that the men could continue their work unharmed for double the quantity of firing. This is partly attributed to the greater heat, and partly to the foulness of the air produced by gunpowder.

But it is under the decks of our men-of-war that greatest benefit is likely to arise from gun-cotton. Not only does the smoke of a broadside fill the between decks with hot and foul air, but the smoke of the windward gun blinds the sight, and hinders the aim of the leeward. When there is no smoke, as with gun-cotton, the aim of every gun may be precise and deliberate. The diminished heat between decks will also tell powerfully in favour of gun-cotton. In our armour-plated ships also there is more value in breech-loading guns than in any other use of artillery. It is one of the necessities of breech-loading mechanism that it be kept clean, and nothing tends more to derange its perfect action than the greater heat which gunpowder imparts to the gun from which it is fired.

That gun-cotton has the convenience of not heating the gun has been thus proved. 100 rounds were fired in thirty-four minutes with gun-cotton, and the temperature of the gun was raised 90°. 100 rounds were fired with gunpowder, and triple the time allowed to cool the gun, which, nevertheless, was heated so much as to evaporate water with a hissing sound, which indicated that its temperature was much above 212°. Under these circumstances the firing with gunpowder had to be stopped, while that with gun-cotton was comfortably continued to 180 rounds.

It is also a matter of practical convenience that gun-cotton, insomuch as it is lighter, can be carried more easily and farther than gunpowder; and it may be wetted without danger, so that when dried again in the open air it is as good for use as before.

III. We have now to ask—is it cheaper? The answer to this question must be qualified—pound for pound it is dearer; we must, therefore, judge of its cheapness by its effect, not by weight merely. But where it does six times as much work, it can then be used at six times the price per pound, and still be as cheap as gunpowder. As far as we yet know, the prices of gun-cotton and gunpowder are nearly equal, and it is only, therefore, where the one has advantages and conveniences beyond the other, and is more especially suited for some specific purpose, that it will have the preference. Effective cheapness will, therefore, depend mainly on which of the two does best the particular kind of duty required of it.

To illustrate how curiously these two powers, gun-cotton and gunpowder, differ in their nature, and how the action of gun-cotton may be changed by mechanical arrangements, we may take one kind of work that is required of both:—If a general want to blow open the gates of a city, he orders an enterprising party to steal up to the gate, with a bag containing 100 lbs. of gunpowder, which he nails to the gate, and by a proper match-line he fires the gunpowder and bursts open the gate. If he nailed a bag of gun-cotton of equal weight in the same place and fired it, the gun-cotton would fail, and the gate would be uninjured, although the 100 lbs. of gun-cotton is sixfold more powerful than the gunpowder. Here, then, gunpowder has the advantage—both weight and effect considered.

But the fault here lies not in the gun-cotton, but the way of using it. If instead of 100 lbs. of gun-cotton in a bag, 25 lbs. had been taken in a proper box made for this purpose, and simply laid down near the gate, and not even nailed to it, this 25 lbs. would shiver the gate into splinters. The bag which suits the powder happens not to suit the gun-cotton.

Gun-cotton is, therefore, a power of a totally different nature from gunpowder, and requires complete study to know its nature and understand its use. It appears that both gunpowder and gun-cotton have special qualities, and may be peculiarly suited for peculiar uses. It is the duty of a wise people to make use of both to the ends they each suit best, without prejudice arising from the accident of novelty or antiquity.

The nature of gun-cotton requires a double study, chemical and mechanical. It is not like steam, the same substance, whether in the form of ice or water or steam. It is one substance when, as gun-cotton, it enters the gun, and quite a different one when it has exploded and leaves the gun. Not only are the solids which enter converted into gas, but they form totally new combinations and substances. So that the marvellous changes which the chemist effects by the magic of his art take place in an instant of time, and during that almost inconceivably minute period of time, in a laboratory intensely heated, old substances are dissolved, their material atoms are redistributed, each atom released selects by natural affinity a new partner, these new unions are cemented, and at the end of this prolific instant totally new combinations of matter, forming what we call new substances, issue from the gun. It so happens that of these new substances, formed out of gun-cotton, all are pure transparent gases, while in the case of gunpowder there remain 68 per cent. of solid residue, and only 32 per cent. are pure gases.

Mechanical Applications of Gun-cotton.

The mechanical application of gun-cotton may be considered to be due exclusively to Major-General Lenk, of the Austrian service. Pure gun-cotton becomes either a powerful explosive agent, or a docile performer of mechanical duty, not according to any change in its composition, or variation in its elements or their proportions, but according to the mechanical structure which is given to it, or the mechanical arrangements of which it is made a part. It was General Lenk who discovered that structure was quality, and mechanical arrangement the measure of power, in gun-cotton; and in his hands, a given quantity of the same cotton becomes a mild, harmless, ineffectual firework, a terrible, irresistible, explosive agent, or a pliable, powerful, obedient workman.

The first form which General Lenk bestowed on gun-cotton was that of a continuous yarn or spun thread. Gunpowder is carefully made into round grains of a specific size. Gun-cotton is simply a long thread of cotton fibre, systematically spun into a yarn of given weight per yard, of given tension, of given specific weight. A hank of a given length is reeled, just like a hank of cotton yarn to be made into cloth, and in this state gun-cotton yarn is bought and sold like any other article of commerce.

This cotton yarn converted into gun-cotton may be called, therefore, the raw material of commerce. In this form it is not at all explosive in the common sense of the word. You may set fire to a hank of it, and it will burn rapidly with a large flame; but if you yourself keep out of reach of the flame, and keep other combustibles beyond reach, no harm will happen, and no explosion or concussion will result. If you lay a long thread of it round your garden walk at night, disposing it in a waving line with large balls of gun-cotton thread at intervals, and light one end of the thread, it will form a beautiful firework, the slow lambent flame creeping along with a will-o'-th'-wisp-looking light, only with a measured speed of six inches per second, or thirty feet a minute, the wind hastening it or retarding it as it blows with or against the line of the thread. This is the best way to commence an acquaintance with this interesting agent.

Care must be taken not to become too familiar with gun-cotton even in this harmless and playful guise. Cotton dresses will readily catch fire from it, and it should not be treated with less care to keep fire from it than gunpowder. In one respect it is less liable to cause danger than gunpowder. Grains of powder are easily dropped through a crevice, and may be sprinkled about in a scarcely noticeable form, but a hank of gun-cotton is a unit, which hangs together and cannot strew itself about by accident.

The *second* form of gun cotton is an arrangement compounded out of the elementary yarn. It resembles the plaited cover of a riding whip; it is plaited round a core or centre which is hollow. In this form it is match-line, and although formed merely of the yarn plaited into a round hollow cord, this mechanical arrangement has at once conferred on it the quality of speed. Instead of travelling as before only six inches a second, it now travels six feet a second.

The *third* step in mechanical arrangement is to enclose this cord in a close outer skin or coating, made generally of India-rubber cloth, and in this state it forms a kind of match-line, that will carry fire at a speed of from twenty to thirty feet per second.

It is not easy to gather from these changes what is the cause which so completely changes the nature of the raw cotton by mechanical arrangement alone. Why a straight cotton thread should burn with a slow creeping motion when laid out straight, and with a rapid one when wound round in a cord, and again much faster when closed in from the air, is far from obvious at first sight; but the facts being so, deserve mature consideration.

The cartridge of a common rifle in gun-cotton is nothing more than a piece of match-line in the second form enclosed in a stout paper tube, to prevent it being rammed down like powder. The ramming down which is essential to the sensitive action of gunpowder is fatal to that of gun-cotton. To get useful work out of a gun-cotton rifle, the shot must on no account be rammed down, but simply transferred to its place. Air left in a gunpowder barrel is often supposed to burst the gun; in a gun-cotton barrel it only mitigates the effect of the charge. The object of enclosing the gun-cotton charge in a hard strong pasteboard cartridge is to keep the cotton from compression and give it room to do its work.

It is a *fourth* discovery of General Lenk, that to enable gun-cotton to perform its work in artillery practice, the one thing to be done is to "give it room." Don't press it together—don't cram it into small bulk; give it at least as much room as gunpowder in the gun, even though there be only one-third or one-fourth of the quantity (measured by weight). One pound of gun-cotton will carry a shot as far as three or four pounds of gunpowder, but that pound should have at least a space of 160 cubic inches in which to work.

This law rules the practical application of gun-cotton to artillery. A cartridge must not be compact; it must be spread out or expanded to the full room it requires. For this purpose a hollow space is preserved in the centre of the cartridge by some means or other. The best means is to use a hollow thin wooden tube to form a core. This tube should be as long as to leave a sufficient space behind the shot for the gun-cotton. On this long core the simple cotton yarn is wound round like thread on a bobbin, and sufficiently thick to fill the chamber of the gun; indeed, a lady's bobbin of cotton thread is the innocent type of the most destructive power of modern times—only the wood in the bobbin must be small in quantity in proportion to the gun-cotton in the charge. There is no other precaution requisite except to enclose the whole in the usual flannel bag.

The artillerist who uses gun-cotton has, therefore, a tolerably simple task to perform if he merely wants gun-cotton to do the duty of gunpowder. He has only to occupy the same space as the gunpowder with $\frac{1}{4}$th of the weight of gun-cotton made up in the bobbin as described, and he will fire the same shot at the same speed. This is speaking in a general way, for it may require in some guns as much as $\frac{1}{3}$rd of the weight of gunpowder and $\frac{11}{10}$ths the bulk of charge to do the same work; a little experience will settle the exact point, and greater experience may enable the gun-cotton to exceed the performance of the gunpowder in every way.

The *fifth principle* in the use of gun-cotton is that involved in its application to bursting uses. The miner wants the stratum of coal torn from its bed or the fragment of ore riven from its lair; the civil engineer wishes to remove a mountain of stone out of the way of a locomotive engine; and the military engineer to drive his way into the fortress of an enemy, or to destroy the obstacles purposely laid in his way. This is a new phase of duty for gun-cotton—it is the work of direct destruction. In artillery you do not want to destroy directly, but indirectly. You don't want to burst your gun, nor even to injure it; and, we have seen, in order to secure this, you have only to give it room.

The fifth principle, therefore, is, to make it destructive—to cause it to shatter everything to pieces which it touches, and for this purpose you have only to deprive it of room. Give it room, and it is obedient; imprison it, and it rebels. Shut up without room, there is nothing tough enough or strong enough to stand against it.

To carry this into effect, the densest kind of gun-cotton must be used. It must no longer consist of fine threads or hollow textures wound on roomy cores. All you have to do is to make it dense, solid, hard. Twist it, squeeze it, ram it, compress it; and insert this hard, dense cotton rope or cylinder or cake in a hole in a rock, or the drift of a tunnel, or the bore of a mine; close it up, and it will shatter it to pieces. In a recent experiment six ounces of this material set to work in a tunnel not only brought down masses which powder had failed to work, but shook the ground under the feet of the engineers in a way never done by the heaviest charges of powder.

To make gun-cotton formidable and destructive squeeze it and close it up; to make it gentle, slow, and manageable, ease it and give it room. To make gunpowder slow and gentle, you do just the contrary: you cake, condense, and harden it to make it slow, safe for guns, and effective.

To carry out this principle successfully, you have to carry it even to the extreme. Ask gun-cotton to separate a rock already half-separated, it will refuse to comply with your request. Give it a light burden of earth and open rock to lift, it will fail. If you want it to do the work, you must invent a *ruse*,—you must make believe that the work is hard, and it will be done. Invent a difficulty and put it between the cotton and its too easy work, and it will do it. The device is amazingly successful. If the cotton have work to do that is light and easy, you provide it with a strong box, which is hard to burst,—a box of iron, for example; close a small charge, that would be harmless, in a little iron box, and then place that box in the hole where formerly the charge exploded harmless, and in the effort it makes to burst that box, the whole of the light work will disappear before it.

The first trial of English-made gun-cotton was made at Stowmarket in the spring of 1861. A charge of twenty-five pounds not only destroyed a tree-stockade, but shattered it into matchwood.

It is, therefore, the nature of gun-cotton to rise to the occasion and to exert force exactly in proportion to the obstacle it encounters. For destructive shells this quality is of the highest value. You can make your shell so strong that nothing can resist its entrance, and when arrived at its destination no shell can prevent its gun-cotton charge from shivering it to fragments.

These are the main principles in the mechanical manipulation of gun-cotton which will probably render it for the future so formidable an instrument of war. Resistances too great for gunpowder only suffice to elicit the powers of gun-cotton. On the other hand, in its elementary state, as the open cotton-yarn, it is playful, slow, gentle, and obedient; there is scarcely any mechanical drudgery you can require of it that it is not as ready and fit to do as steam, or gas, or water, or other elementary power.

In conclusion, I may be asked to say as a mechanic what I think can be the nature and source of this amazing power of gun-cotton. In reply, let me ask, Who shall say what takes place in that pregnant instant of time when a spark of fire enters the charge, and one-hundredth part of a second of time suffices to set millions of material atoms loose from fast ties of former affinity, and leaves them free every one to elect his mate, and uniting in a new bond of affinity, to come out of that chamber a series of new-born substances? Who shall tell me all that happens then? I will not dare to describe the phenomena of that pregnant instant. But I will say this, that it is an instant of intense heat—one of its new-born children is a large volume of steam and water. When that intense heat and that red-hot steam were united in the chamber of that gun and that mine two powers were met whose union no matter yet contrived has been strong enough to compress and confine. When I say that a gun-cotton gun is a steam gun, and when I say that at that instant of intense heat the atoms of water and the atoms of fire are in contact atom to atom, it is hard to believe that it should not give rise to an explosion infinitely stronger than any case of the generation of steam by filtering the heat leisurely through the metal skins of any high-pressure boiler.

ACADEMY OF SCIENCES.

August 17.

Father Secchi continues his observations "*On the Spectra of the Planets*," giving on this occasion a more particular account of that of Jupiter. The present communication confirms the existence of special atmospheric lines, which do not exactly accord with our own. The line C is absolutely wanting in Jupiter, and the position of others is different. The author believes in the existence of the solar lines in the spectrum of the planet, but states that its atmosphere has a stronger absorbing power than our own.

M. Chatin has made a most extensive series of researches. "*On the Proportion of Sugar contained in the Sap and the Vegetable Juices generally.*" But little can be gathered from this communication beyond the fact that the amount of sugar differs greatly in different plants, which was well known before. He estimated the sugar by the fermentation test.

For those interested in the subject, we may state that the Abbé Chevallier describes a great find of flint implements near Grand-Pressigny (Indre et Loire). The tools are here found not in single specimens, but in thousands. Two explorers brought to the author some hundreds of kilogrammes of the instruments gathered in a few hours.

M. Renault communicated an interesting "*Contribution to the History of Protochloride of Copper.*" A plate of copper dipped in a solution of bichloride of copper, perchloride of iron, dilute *aqua regia*, or any solution which parts easily with chlorine, becomes covered with a greyish white layer of cuprous chloride which is remarkable for its sensibility to light. A negative placed on a plate so sensitivised gives a positive picture of great beauty. We shall return to this paper.

M. E. Kopp described "*A Process for Obtaining Yellow Alizarine from the Green Alizarine of Commerce.*" The author simply boils it repeatedly with schist oil, which dissolves the yellow and leaves the green, part of the former depositing in the crystalline state as the oil cools. The oil is then shaken with weak caustic soda, which removes the part remaining in solution. The soda solution is afterwards separated from the oil and treated with sulphuric acid, which immediately precipitates the yellow alizarine, now only requiring to be washed and dried.

The blackish-green matter left by the oil in the first operation when treated with diluted nitric acid yields a yellow colouring matter soluble in alkaline liquors, and slightly soluble in water, to which the author has given the name *xanthazarine*, and which dyes wool and silk, mordanted or not, much the same colour as yellow wood. Reducing agents convert this xanthazarine into a new red colouring matter.

M. Caron returns to the question of the "*Clementation of Iron by Carbonic Oxide.*" He believes that in the operation carried out on a commercial scale at a red heat carbonic oxide cannot be regarded as an useful agent, but he details some experiments which show that under conditions it is possible by means of it to charge iron with as much carbon as one may wish. He took a gramme of pure oxide, reduced it by means of hydrogen, the iron obtained weighing 0·7 of a gramme, and after exposing this to carbonic oxide at a low temperature (not high enough to soften glass) for six hours the matter obtained weighed 3·170 grammes. At a red heat he states that practically no absorption of carbon takes place. This paper is a reply to that of M. Margueritte, which we noticed a week or two ago.

M.M. Leplay and Taillard have injected the spores of *Penicillum glaucum* and the *Oidium Tuckeri* into the veins of dogs, but nothing came of it. Our medical readers will remember that Penicillium glaucum, it has been said, will cause psoriasis, and the oidium phlegmonous inflammations and other discomforts. The authors of this paper, however, could produce none of these disorders.

NOTICES OF BOOKS.

International Exhibition. Report on Class II. Section A. Industry of Manures.

Tracing the history of the manufacture of artificial manures since 1840, the Reporter first comes to the patent of Mr. Lawes for the manufacture of superphosphate of lime (1842), and it is very properly pointed out that it was Liebig who first suggested the employment of this material as a manure. Mr. Lawes afterwards disclaimed the use of all but mineral phosphates, and made other alterations which look like an admission of his source of inspiration. Subsequently (1845) Liebig himself patented a manure in this country; but in this makes use of calcined bones. These, he states in his work on "Artificial Manures," act "sufficiently quickly in the soil, being deprived of the gelatine, which diminishes the solubility of raw bones in soils rich in organic matter."

It must be confessed that there is a strong resemblance between these two celebrated patents, and probably curious questions would have been raised by chemists if either had been disputed in a court of law. The patents, however, are now only matters of history; but the trade in superphospate of lime is larger than ever, and Mr. Lawes favours the Reporter with the following particulars as to the most improved method of manufacturing the article, with its average composition and price:—

"The phosphatic materials are first ground to a very fine powder by mill-stones; the powder is then carried up by means of elevators, and discharged continuously into a long iron cylinder, having agitators revolving within it with great velocity. A constant stream of sulphuric acid, of sp. gr. 1·66, enters the cylinder at the same end as the dry powder, and the mixture flows out at the other end in the form of a thick mud, having taken three to five minutes in passing through the machine. The quantity turned out by such a mixing-machine is about 100 tons daily. The semi-fluid mass runs into covered pits 10 to 12 feet deep, each of sufficient size to hold the produce of the day's work. It becomes tolerably solid in a few hours, but retains a high temperature for weeks, and even months, if left undisturbed.

"The composition of a superphosphate of good quality, made partly from mineral phosphate and partly from ordinary bones, may be stated as follows :—

Soluble phosphate . .	22	to	25	per cent.
Insoluble phosphate . .	8	,,	10	,,
Water	10	,,	12	,,
Sulphate of lime . .	35	,,	45	,,
Organic matter . . .	12	,,	15	,,

Nitrogen, 0·75 to 1·5 per cent.

"If sufficient sulphuric acid were used to decompose the whole of the phosphate of lime, the product would be too wet to be packed in bags, and would require either to be mixed with extraneous substances of a dry and porous nature, or to be artificially dried.

"The price of the best descriptions of superphosphate ranges from 5*l.* 15s. to 6*l.* 10s. per ton, and of that made from purely mineral phosphate from 4*l.* to 5*l.* 5s. per ton."

Some idea of the extent of the trade in this article may be gathered from the statement that Mr. Lawes himself produces 18,000 to 20,000 tons of superphosphate annually; and the total yearly production of superphosphate in Great Britain is estimated by him as ranging from 150,000 to 200,000 tons.

Of the raw materials annually worked up into superphosphate in Great Britain, Mr. Lawes estimates that about half is derived from the deposits of fossil bone-earth, or coprolite, discovered of late years in several parts of England. Bone-ash, chiefly imported from South America, animal charcoal from Germany, and bones from all parts of the world, together supply about 40 per cent. more of the raw material; while the remaining 10 per cent. of the total supply is made up by guano (chiefly of the less nitrogenous and more phosphatic kinds), with a little apatite (say 200 to 500 tons per annum) obtained from Spain, Norway, and America.

The Reporter next comes to imported manures, and naturally commences with Peruvian guano, which appears to have been first imported about the year 1838, and sold for 20*l.* a ton. In 1841 it had been tried on sixty farms, and the importations soon largely increased. In 1842 only 182 tons were imported, but in the following year the importations reached 4667 tons, and in 1862 they amounted to the enormous quantity of 435,000 tons. Of this vast total, it is said that from a fourth to a third is retained for use in the United Kingdom.

When speaking of the price of Peruvian guano, we are somewhat surprised to see that the Reporter has nothing to say against the monopoly of this article which is maintained, and which to some extent influences the price of all manufactured manures.

In a section on the "good and evil of the trade in manures," the author seems to adopt the narrow views of Liebig on the subject of the exportation of fertilising agents. We quote the passage at length, since it exhibits the ideas of Liebig in a very strong light, and also to some extent refutes them :—

"The manure trade (he says) presents itself in two aspects; the one advantageous, the other detrimental to mankind. Nothing can be more advantageous than the collection and utilisation of fertilising residua formerly cast away as worthless. The fossil phosphates quarried out of the bosom of the earth, and the guano extracted (by the successive intervention of seaweeds, fishes, and penguins) from the depths of the ocean, are evidently so much treasure fairly won from Nature for the legitimate enrichment of mankind. Even the withdrawal of recent bones and bone ash, from plains untenanted as yet save by wild cattle, to fertilise the cornfields of the populous old world, must be accounted a legitimate commerce. But the boundary line is overpassed, and the manure trade becomes abnormal, when bones are withdrawn from one populous country to enrich the exhausted fields of another.

"Nor is the detriment thus occasioned confined to the country whose soil is impoverished. In the closely-knit relations of modern commerce, the impoverishment of any one commercial country reacts on the prosperity of all the others, by diminishing the stock of exchangeable wealth in the world. If Germany, for instance, grows less corn, her purchasing power for foreign goods, say French or British, is proportionately diminished, and commerce suffers *pro tanto.* The gain to France or England is, therefore, but illusory, if either robs a neighbour's soil to fertilise her own.

"In a work just published,* Baron Liebig sternly rebukes England for her over-eagerness to buy up, in the form of bones, the phosphatic wealth of countries less advanced than herself in financial and industrial power, and for the apparent recklessness with which she squanders forth these treasures (ill-gotten and ill-spent) down her innumerable sewers to the sea. The great agricultural teacher manifests alarm at the superabundant zeal with which the most diligent of his pupils obeys his lessons; and to other nations he earnestly points out the ruinous consequences that must ensue to them, from the exportation of phosphates, drawn from their soil, to stay the exhaustion of the English fields. His cry of warning is couched in terms of almost passionate invective :—

"England (he exclaims) is robbing all other countries of the conditions of their fertility. Already, in her eagerness for bones, she has turned up the battle-fields of Leipzic, Waterloo, and of the Crimea; already from the catacombs of Sicily she has carried away the skeletons of many successive generations. Annually she removes from the shores of other countries to her own, the manurial equivalent of three millions and a-half of men; whom she takes from us the means of supporting, and squanders down her sewers to the sea. Like a vampire she hangs upon the neck of Europe, nay, of the entire world, and sucks the heartblood from nations, without a thought of justice towards them, without a shadow of lasting advantage for herself.

"It is impossible (he proceeds to say) that such iniquitous interference with the Divine order of the world should escape its rightful punishment; and this may, perhaps, overtake England even sooner than the countries she robs. Most assuredly a time awaits her, when all her riches of gold, iron, and coal will be inadequate to buy back a thousandth part of the conditions of life, which for centuries she has wantonly squandered away."

Doubtless it is very sinful in us to waste our natural manure in the way we do, and one day we shall be obliged to seriously consider the subject. In the meantime, if we did not buy manure we should have to buy more food from foreign countries; but nobody argues that a country is impoverished by exporting its surplus food. How then can it be by exporting its surplus manure? But already it seems that if we *have* robbed Germany of its bones, we now export to it our coprolites, and thus, as the Reporter says, "the balance of trade seems to be arriving at a just equilibrium in the matter, as indeed it always does, if only it be left to swing freely."

The next section, entitled "Modern Historical Events connected with the Development of Manurial Industry," is a remarkable one.

(To be continued.)

A Dictionary of Chemistry, &c. By Henry Watts, B.A., F.C.S. Part XVIII. London: Longman and Co. 1864.

The present part includes the articles from Iron to Lactucarium, and the student will find in it two valuable essays on Isomerism and Isomorphism, which will well repay attentive perusal.

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* 'Einleitung in die Naturgesetze des Feldbaues.' Von Justus von Liebig. Braunschweig: Vieweg und Sohn, 1863.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Notices to Proceed.

856. Edward Thomas Hughes, Chancery Lane, London, "An improved controlling apparatus for registering the quantity and quality of alcohol obtained in distilleries."—A communication from Traugott Glaeser, Brieg, and Ernst Hofmann, Breslau, Prussia.—Petition recorded April 6, 1864.

877. John Picking, Spitalfields, "Improvements in refrigerators or apparatus for refrigerating or cooling wort and other liquids."

887. William Clark, Chancery Lane, Middlesex, "Improvements in preparing or treating vegetable fibrous materials."—A communication from Hubert Dupré, Boulevart St. Martin, Paris.—Petitions recorded April 8, 1864.

893. John Hawkins Simpson, Kilmeena, Ireland, "Certain improvements in printing from type by electricity."—Petition recorded April 9, 1864.

953. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in metallic capsules."—A communication from William Betts, Bordeaux, France.—Petition recorded April 15, 1864.

959. William Clark, Chancery Lane, Middlesex, "Improvements in the preservation of animal matters."—A communication from Jean Pierre Lies Bodart, Boulevart St. Martin, Paris.

965. Alfred Vincent Newton, Chancery Lane, Middlesex, "An improved mode of manufacturing cerealine."—A communication from James Brown, Philadelphia, U.S.A.—Petitions recorded April 16, 1864.

1125. Thomas Henry Rees, Hatcham, Surrey, "Improvements in blue colouring matters for washing purposes, and in receptacles for containing the same ready for use."—Petition recorded May 4, 1864.

1161. Alfred Vincent Newton, Chancery Lane, Middlesex, "Improved apparatus for facilitating the inhalation of medicinal substances."—A communication from John Jones, New York, U.S.A.—Petition recorded, May 7, 1864.

1196. Thomas Matthew Gisborne, Lymington, Southampton, "Improvements in kilns for burning bricks, tiles, and other earthenware or ceramic articles, limestone, and ores."—Petition recorded May 11, 1864.

1642. Thomas Nichols, New York, U.S A., "Improvements in the preservation of eggs, and in apparatus to be used in connection therewith."—Petition recorded July 1, 1864.

1706. Thomas Sharp, Nashville, Tennessee, North America, "Certain improvements in tanning hides and in the apparatus employed therein."—Petition recorded July 9, 1864.

CORRESPONDENCE.

Continental Science.

Paris, August 20.

The members of M. Leverrier's excellent Astronomical Society have had quite a gala week of it examining M. Tempel's comet with the large refractor belonging to them at the Observatory. The poor comet has had a great deal to bear in the way of abuse. M. Z. says he brought the hot weather; M. Y. says he is not bright enough; M. X. insinuates that he is keeping away the rain; and M. W. insults the poor fellow by mocking at his want of a tail. No wonder at his stopping so short a time. However, M. Donati announces the discovery of another amongst the tresses of Berenice's hair.

The first gratuitous course of twenty-five lectures on Chemistry at the Museum of Natural History has been attended by over fifty pupils, mostly from the schools of medicine and pharmacy. When I tell you that the lectures are by MM. Chevreul, Fremy, and E. Becquerel, you will not wonder at the success they have met with.

Those who have known and felt the great influence exercised in cheapening good French literature of every description by M. Hachette will regret to hear of his death. He was followed to his grave by a large crowd of literary notabilities. He was greatly beloved and respected by his contemporaries, and was the John Murray of this side of the Channel.

Our friend the *Cosmos* has just discovered a new county in England, but forgets to tell us whether it is east, west, north, or south. In announcing the purchase of a very perfect specimen of the plesiosaurus by the British Museum, your contemporary states that it was discovered "*sur la côte du* Torsetzir"! After referring to numerous gazetteers on the subject, and diligently examining the maps of Poland, Hungary, and Bohemia, a facetious English friend suggests that Dorsetshire is meant, but I have rejected his hypothesis as absurd.

Still another economical nitrate of silver bath for positive prints! It is the invention of M. Grüner, a Berlin photographer. Nitrate of lead, 12·5 parts; nitrate of silver, 5 parts; water, 100 parts. The paper being floated and dried as usual is passed through a bath of solution of potash containing 35 per cent. of alkali, which turns it to a yellowish brown. The paper is then dried, printed, toned, and fixed in the usual manner.

M. Georges Ville has been down at his experimental farm at Belle Eau, in the Department of the Drome, lecturing to the farmers of that locality. Artificial manure appears to have been the subject of his lectures, his object being to demonstrate that artificial manure made on correct principles was better than any other. He showed them several fields of corn treated with different artificial and natural manures, and some without any manure at all, and proved to them incontestably that the field fertilised with an artificial manure containing the proper admixture of phosphates, lime, potash, nitrogen, &c., produced the best results. Of those present many were cocks who did not like to leave the dunghills they had been accustomed to *ab ovo*, and who protested against any such innovations; but M. Ville answered all their objections, and, let us hope, convinced them of the fallacy of their old-world notions. The farm at Belle Eau, like that at Vincennes, has been placed at the disposal of M. Ville by the Emperor.

A M. Martin, of Jersey, has seriously announced to the Academy of Sciences (which has received this announcement with great gravity) that a cat of that town had recently given birth to a young one half-cat half-dog! This reminds one of the celebrated hybrid half-fowl half-rabbit that so nearly deceived one of your most popular naturalists. Surely our Academy, like your *Times*, has its "silly season."

MISCELLANEOUS.

Cavendish Society.—We may announce that the sixteenth volume of Gmelin's "Chemistry" is now being issued to the subscribers for 1862. It brings the work down as far as bodies containing 34 atoms of carbon, and it is said that one more volume will complete the work.

University of London.—First B.Sc. Examination, 1864.—The following gentlemen took honours in Chemistry and Natural Philosophy:—

First Class.

Wright, C. R. A. (Exhibition), Owen's College.
Brown, J. C., University of Aberdeen & School of Mines.

Third Class.

Exall, William Henry, King's College.
Graham, Charles, University College.
Kisch, Albert, St. Thomas's and London Hospitals.

Death of Dr. R. Dundas Thompson.—Dr. Robert Dundas Thompson died on Wednesday last at Dunstable. He was in the 60th year of his age. His first degrees were taken in Glasgow, in which university he afterwards held the chair of chemistry, but in 1859 became a member of the Royal College of Physicians. He filled the chair of chemistry at St. Thomas's Hospital for many sessions, was physician to the Scottish Hospital and to the Blenheim Free Dispensary, of which he was one of the founders. He was a fellow of the Royal Society, and of the London, Edinburgh, Royal Medical, and the Chirurgical, and Chemical Societies, and president of the British Meteorological Society. He also occupied the position of medical officer of health to the borough of Marylebone.

Lingard (Administratrix) v. Clay and Abraham.—This was an action tried before Mr. Baron Pigott at the Liverpool Assizes. The action was brought under Lord Campbell's Act for the loss of a husband, the damages claimed being 3000*l.* The late Mr. Lingard met his death owing to an unfortunate mistake by Richard Poole, an assistant in the establishment of Messrs. Clay and Abraham, chemists, Liverpool. A number of physicians and chemists attended to show that the mode of keeping the poisons in Messrs. Clay and Abraham's establishment was the common and most approved mode. It was announced, however, that the parties had agreed to a verdict of 1500*l.* 15*s.*, which was apportioned thus:—One shilling to the eldest child, who inherits upon his father's death, 500*l.* to the widow, and 500*l.* to each of the other children.

Mineral Statistics for 1863.—The following tables place the whole question of the value of our mining operations at once before the eye:—

General Summary, of which Returns are given, for 1863.

Minerals	Quantity.	Value.
Gold quartz, tons	385	£1,500
Tin ore, tons	15,157	963,985
Copper ore, tons . . .	210,947	1,100,554
Lead ore, tons	91,283	1,193,530
Silver ore, tons	88	5,703
Zinc ore, tons	12,941	29,968
Iron ore, tons	9,101,552	3,240,890
Pyrites, tons	95,376	62,035
Wolfram, tons	13	67
Uranium, cwts. . . .	3	23
Gossans, tons	4,424	4,576
Arsenic, tons	1,444	1,200
Coals (sold and used), tons .	86,292,215	20,572,945
Earthy minerals, estimated at .	—	1,975,000
Total value of the minerals produced in 1863		£29,151,376

Metals produced from British Minerals and Coals.

	Quantity.	Value.
Gold, ozs.	552	£1,747
Tin, tons	10,006	1,170,702
Copper, tons	14,247	1,409,608
Lead, tons	68,220	1,418,985
Silver, ozs.	634,004	174,351
Zinc, tons	3,835	90,889
Iron (pig), tons	4,510,040	11,275,100
Total value of the above . . .		15,541,382
Estimated value of other metals .		250,000
Coals		20,572,945
Total value of the metals obtained and coals produced in 1863		£36,364,327

Poisoning by Calabar Beans.—There is no doubt that the poisoning at Liverpool, mentioned last week, resulted from eating Calabar beans. Dr. Edwards has been kind enough to forward us some of those found in the rubbish. It seems extraordinary that an article fetching so high a price should be disposed in such a careless way. The following is the chemical evidence given by Dr. Edwards, at the inquest on Michael Russell, who died from the effects of the poison:—John Baker Edwards deposed: I am an analytical chemist, and lecturer on medical jurisprudence, at the Royal Infirmary School of Medicine, Liverpool. On Friday, the 12th instant, I attended a *post-mortem* examination of the remains of the deceased Michael Russell, and removed the stomach, intestines, and parts of the viscera of deceased in jars, which I conveyed to my laboratory at the Royal Institution, for chemical examination. On the same day I received from Inspector Moore a parcel of beans, said to be similar to those of which the said Michael Russell had eaten. The beans are those known in medicine as Calabar ordeal beans (*Physostigma venenosum*). I proceeded to make an alcoholic extract of the beans, also of the contents of deceased's stomach and of the contents of deceased's intestines. The stomach contained only five fluid ounces of fluid, consisting of a few fragments of the bean, and the remains of a mustard emulsion which had been administered shortly before death. The quantity of alcoholic extract from the stomach was therefore very small, and its reactions were obscured by the mustard. After further purification by ether, an extract was obtained which caused marked contraction of the pupil in the eye of a rabbit when applied to it externally. From the intestines of deceased I obtained 17 fluid ounces of an emulsive fluid, which, after digestion with the alcohol, yielded an extract, which was then purified by ether and evaporated. This etherial extract corresponded in its reactions with a similarly prepared extract of the beans under examination. The chemical reactions on a watery solution of the etherial extract are as follows:—1. A pink colour, struck by caustic potash, which gradually increases in intensity to a deep red, and when mixed with chloroform forms a deep red chloroformic solution, which separates from the clear yellowish supernatant liquor. 2. A red colour, struck by strong sulphuric acid, with separation of a resinoid coagulum. 3. A violet colour, changing to red by sulphuric acid and crystals of bichromate of potash. 4. A similar colour, with sulphuric acid and binoxide of manganese, retaining the purple colour for a long time. 5. A yellow precipitate, with solution of iodine in iodide of potassium. 6. A purple colour, with tri-chloride of gold and reduction of metallic gold. 7. A yellow colour, struck with caustic ammonia, which, exposed for some hours to light, turned green, and finally a deep blue. I applied a few drops of the aqueous emulsion of this etherial extract obtained from the intestines of deceased to a frog's back, by insertion under the skin. In a short time the animal manifested an indisposition to movement, and became very quiet. In the course of an hour it became unable to jump, or to remove the position in which its limbs were placed, and in about two hours it became perfectly flaccid and insensible to any external irritation; although stimulated by strychnine, it was incapable of being roused to muscular exertion, and soon expired, having previously exhibited very irregular respiration and pulsation. A second portion of the emulsion was exhibited to a mouse, which became soon paralysed in its limbs, and died after a few hours. A third portion was introduced into the circulation of a mouse by the ear, and after twenty-four hours the poison operated fatally, by complete paralysis of the limbs and senses, and the animal died by syncopa. A fourth portion of the emulsion from the intestines of deceased applied to the eye of a rabbit caused strong contraction of the pupil after three-quarters of an hour. Similar results were obtained by an etherial extract of the bean itself.

ANSWERS TO CORRESPONDENTS.

Erratum.—Page 89, col. 2, five lines from bottom, for *dindes* read *doubles.*

M. X.—Abstracts of the Friday evening lectures alone are published.

G. L.—We do not believe there is a patent.

Received.—R. S.; Dr. Adriani; Dr. Edwards, with thanks.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Properties of Silicic Acid and other analogous Colloidal Substances,* *by* Thomas Graham, *F.R.S.*

(PRELIMINARY NOTICE.)

(*Continued from page 99.*)

The production of the compounds of silicic acid now described indicates the possession of a wider range of affinity by a colloid than could well be anticipated. The organic colloids are no doubt invested with similar wide powers of combination, which may become of interest to the physiologist. The capacity of a mass of gelatinous silicic acid to assume alcohol, or even oleine, in the place of water of combination, without disintegration or alteration of form, may perhaps afford a clue to the penetration of the albuminous matter of membrane by fatty and other insoluble bodies, which seems to occur in the digestion of food. Still more remarkable and suggestive are the *fluid* compounds of silicic acid. The fluid alcohol-compound favours the possibility of the existence of a compound of the colloid albumen with oleine, soluble also and capable of circulating with the blood.

The feebleness of the force which holds together two substances belonging to different physical classes, one being a colloid and the other a crystalloid, is a subject deserving notice. When such a compound is placed in a fluid the superior diffusive energy of the crystalloid may cause its separation from the colloid. Thus, of hydrated silicic acid, the combined water (a crystalloid) leaves the acid (a colloid) to diffuse into alcohol; and if the alcohol be repeatedly changed the entire water is thus removed, alcohol (another crystalloid) at the same time taking the place of water in combination with the silicic acid. The liquid in excess (here the alcohol) gains entire possession of the silicic acid. The process is reversed if an alcogel be placed in a considerable volume of water. Then alcohol separates from combination, in consequence of the opportunity it possesses to diffuse into water; and water, which is now the liquid present in excess, recovers possession of the silicic acid. Such changes illustrate the predominating influence of mass.

Even the compounds of silicic acid with alkalies yield to the decomposing force of diffusion. The compound of silicic acid with 1 or 2 per cent. of soda is a colloidal solution, and, when placed in a dialyser over water *in vacuo* to exclude carbonic acid, suffers gradual decomposition. The soda diffuses off slowly in the caustic state, and gives the usual brown oxide of silver when tested with the nitrate of that base.

The pectisation of liquid silicic acid and many other liquid colloids is effected by contact with minute quantities of salts in a way which is not understood. On the other hand, the gelatinous acid may again be liquefied and have its energy restored by contact with a very moderate amount of alkali. The latter change is gradual, one part of caustic soda, dissolved in 10,000 water, liquefying 200 parts of silicic acid (estimated dry) in 60 minutes at 100° C. Gelatinous stannic acid also is easily liquefied by a small proportion of alkali, even at the ordinary temperature. The alkali, too, after liquefying the gelatinous colloid, may be separated again from it by diffusion into water upon a dialyser. The solution of these colloids, in such circumstances, may be looked upon as analogous to the solution of insoluble organic colloids witnessed in animal digestion, with the difference that the solvent fluid here is not acid but alkaline. Liquid silicic acid may be represented as the "peptone" of gelatinous silicic acid; and the liquefaction of the latter by a trace of alkali may be spoken of as the peptisation of the jelly. The pure jellies of alumina, peroxide of iron, and titanic acid, prepared by dialysis, are assimilated more closely to albumen, being peptised by minute quantities of hydrochloric acid.

Liquid Stannic and Metastannic Acids.—Liquid stannic acid is prepared by dialysing the bichloride of tin with an addition of alkali, or by dialysing the stannate of soda with an addition of hydrochloric acid. In both cases a jelly is first formed on the dialyser; but as the salts diffuse away the jelly is again peptised by the small proportion of free alkali remaining; the alkali itself may be removed by continued diffusion, a drop or two of the tincture of iodine facilitating the separation. The liquid stannic acid is converted on heating into liquid metastannic acid. Both liquid acids are remarkable for the facility with which they are pectised by a minute addition of hydrochloric acid as well as by salts.

Liquid Titanic Acid is prepared by dissolving gelatinous titanic acid in a small quantity of hydrochloric acid without heat, and placing the liquid upon a dialyser for several days. The liquid must not contain more than 1 per cent. of titanic acid, otherwise it spontaneously gelatinises, but it appears more stable when dilute. Both titanic and the two stannic acids afford the same classes of compounds with alcohol, &c., as are obtained with silicic acid.

Liquid Tungstic Acid.—The obscurity which has so long hung over tungstic acid is removed by a dialytic examination. It is, in fact, a remarkable colloid, of which the pectous form alone has hitherto been known. Liquid tungstic acid is prepared by adding dilute hydrochloric acid carefully to a 5 per cent. solution of tungstate of soda in sufficient proportion to neutralise the alkali, and then placing the resulting liquid on a dialyser. The addition of hydrochloric acid must be repeated three or four times, and the dialysis continued for several days in order to remove the whole alkali. It is remarkable that the *purified* acid is not pectised by acids, salts, or alcohol at the ordinary temperature. Evaporated to dryness, it forms vitreous scales, like gum or gelatine, which sometimes adhere so strongly to the surface of the evaporating dish as to detach portions of it. It may be heated to 200° C. without losing its solubility or passing into the pectous state, but at a temperature near redness it undergoes a molecular change, losing at the same time 2·42 per cent. of water. When water is added to unchanged tungstic acid it becomes pasty and adhesive like gum, and it forms a liquid with about one-fourth its weight of water, which is so dense as to float glass. The solution effervesces with carbonate of soda. The taste of tungstic acid dissolved in water is not metallic or acid, but rather bitter and astringent. Solutions of tungstic acid containing 5, 20, 50, 66·5, and 79·8 per cent. of dry acid, possess the following densities at 19°, 1·0475, 1·2168, 1·8001, 2·396, and 3·243. Evaporated *in vacuo* liquid tungstic acid is colourless, but becomes green in air and light, apparently from the deoxidating action of organic matter. Liquid silicic acid is protected from pectising when mixed with tungstic acid—a circumstance probably connected with the formation of the double compounds of these acids, which M. Marignac has lately indicated.

Molybdic Acid has hitherto been known (like tungstic acid) only in the insoluble form. Crystallised molybdate of soda dissolved in water is decomposed by the addition of hydrochloric acid in excess without any immediate precipitation. The acid liquid thrown upon a dialyser may gelatinise after a few hours, but again liquifies spontaneously, when the salts diffuse away. After repeated additions of hydrochloric acid and a diffusion of three days, about 60 per cent. of liquid molybdic acid remains behind in a pure condition. The solution is yellow, astringent to the taste, acid to test-paper, and possesses much stability. The acid may be dried at 100°, and then heated to 200° without losing its solubility. Dry molybdic acid has the same gummy aspect as tungstic acid, and deliquesces slightly when exposed to damp air. Both acids lose their colloidality when combined with soda, and give a variety of crystallised salts. The pure liquid acids also become insoluble when heated for some time with hydrochloric and other strong acids.

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* Abstracted from the *Proceedings* of the Royal Society, with additions by the author.

On the Determination of Water in Organic Substances, by M. Cl. Winckler.

This determination is founded on the change of colour which anhydrous chloride of cobalt undergoes in absorbing water. Dry chloride of cobalt dissolves in alcohol of a density of 0·792, preserving a beautiful blue colour. Hydrated bodies in presence of this solution abandon their water, and the colour turns to red. The operation is begun by titrating the solution of cobalt, to ascertain the quantity of it which must be added to a certain amount of water to produce a fixed colour. In this way the author has determined the alcoholic strength of mixtures of alcohol and water.—*Bulletin de la Société Chimique*, vi., 460, 64.

A New Method of Estimating Sulphuric Ether, by MM. Regnauld *and* Adrian.

The purity of ether is commercially estimated by its density, but this is not a rigorous mode of determination, since it is disputed what instrument is to be used. There is also the incorrectness in the graduation of commercial instruments, and, moreover, the temperature is not taken into account.

Some degree of regularity is attained by using a gravimeter, but by itself this determination is insufficient, since the ether is mixed at the same time with water and alcohol in variable proportions.

The first step towards obtaining a correct estimate is to simplify the nature of this complex product.

Having ascertained that carbonate of potash completely dehydrated ether, the authors found that the same salt brought alcohol mixed with ether to 98° centesimal without going beyond.

These points established, they base their process on the estimation of the degree of purity of ether by determining its density before and after the action of dry carbonate of potash. They have arranged a table so as to dispense with calculation. The proportions of pure ether, alcohol, and water contained in any ether can be determined by two gravimetric experiments.

Note.—The temperature for the two experiments should be kept rigorously at + 15 , and the shaking of the mixture with the dry carbonate of potash, which is effected in a stopped flask, should last from twenty-five to thirty minutes.—*Bulletin de la Société Chmiique*, vi., 461, 64.

Action of Light on Santonine.—Photo-Santonic Acid, by M. Sestini.*

Santonine, it is well known, is coloured yellow by exposure to solar light, and this takes place in a vacuum as well as in the air. It does not take place, however, when the actinic rays are cut off by means of a solution of nitrate of uranium.

Crystals of santonine reduced to powder and then exposed to light, not only change colour, but evolve a resinous odour, and acquire a very bitter taste. Water added to this changed santonine acquires a yellow colour, presents an acid reaction, and has a bitter taste. On distillation the same water yields an acid liquid which reduces nitrate of silver and bichloride of mercury, and precipitates acetate of lead white. The author concluded that the volatile matter formed during the colouration of santonine by light was formic acid. On evaporation to dryness the distillate gives a deep red-coloured resinous residue.

By treatment with water the coloured santonine almost entirely lost its odour. On treatment with alcohol it now in great part dissolved, giving a yellowish solution, which, on evaporation, left a reddish-yellow residue, the greater part of which was soluble in ether. The ethereal solution left an uncrystallisable residue of an amber colour, and with a very bitter taste.

In subsequent experiments made by exposing santonine to light under water from which all air had been carefully expelled, the author obtained exactly the same results, and hence concluded that by exposure to solar light santonine is changed into formic acid, and an uncrystallisable substance much more soluble in alcohol and ether than santonine itself, and also a red resinous substance. To the yellow uncrystallisable substance he has given provisionally the name *photo-santonic acid*.

The acid, on analysis, gave results which agree very nearly with the formula $\mathrm{C}_{11}\mathrm{H}_{14}\mathrm{O}_3$. Its chemical properties will be described in a future memoir.

On the Estimation of Nitric Acid in Waters, by M. C. Weltzien.†

Finding that determinations made by the usual methods did not give concordant results, the author adopted the following process. After concentrating the water, the lime and magnesia were precipitated by means of carbonate of soda, and thus nitrate of soda was obtained. The solution of this was evaporated to dryness, the dried residue mixed with finely divided copper, obtained by reducing the oxide by means of hydrogen. The mixture was then placed in a combustion tube, with the precautions necessary in estimating nitrogen by volume.

In such an analysis the author mentions that nitrogen existing in nitrate of ammonia or in organic matter and also in nitrites will be overlooked.

Use of Silica in Organic Analysis, by M. Schaller.‡

Some months ago M. Schaller gave a process for preparing what he supposed to be ferricyanide of ammonium, which is used in making aniline black. His process consisted in substituting ammonium for potassium by double decomposition, but he has since discovered that the whole of the potassium is not exchanged, and that the salt formed is really a double ferricyanide of ammonium and potassium.

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* *Bulletin de la Société Chimique de Paris*, July, 1864, p. 21.

† *Ibid.*, August, 1864, p. 87.

‡ *Ibid.*, August, 1864, p. 93.

In the course of his experiments he found a difficulty in estimating the carbon in the presence of the potassium in the compound; and it occurred to him to make a combustion with pure calcined silica in place of oxide of copper. The process succeeded perfectly.

The analysis of bitartrate of potash may be made in the same way, and the carbon and hydrogen estimated at the same time.

The combustion tube is charged in the usual way for estimating carbon and hydrogen, but in place of oxide of copper the substance to be analysed is mixed with about its own weight of silica. The mortar is then rinsed with oxide of copper, which is placed in the tube and shaken with the previous mixture.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, June 3, 1864.

"*On Recent Chemical Researches in the Royal Institution,*" *by* Edward Frankland, *Esq., F.R.S., Professor of Chemistry, Royal Institution.*

Amongst the branches of inquiry that have engaged the attention of chemists during the past fifteen years, there can scarcely be two opinions as to the paramount importance of those investigations which have had for their object the discovery of the internal structure of chemical compounds, and especially of organic compounds; for it is by thus studying the architecture of these bodies that we become acquainted with the plans according to which Nature herself constructs them under the influence of what we term vitality, and that we are enabled to imitate her operations. The vast number of organic compounds that can now be produced, without the aid of life in any form, some of them even constituting a part of the food of man, affords ample testimony to the importance of this field and the success with which it has been cultivated.

The ultimate analytical composition of a chemical compound affords us little or no information available for the production of that compound artificially; but the moment the internal arrangement of the atoms becomes known the constructive process at once suggests itself. Such a problem may be attacked in two distinct ways, either by taking the compound to pieces, or by building it up from its proximate constituents. More than twelve years ago the speaker had applied the latter or synthetical process to the investigation of organic compounds containing metals, some of the results of which he had communicated to the members on a previous occasion. A like scrutiny must be applied to other families of organic substances if we are to become equally acquainted with their molecular construction. It was the application of the synthetical process to an important family of organic substances that had formed the basis of the investigations recently carried on in the chemical laboratory of the Institution. In the execution of this work the speaker had been enthusiastically joined by his friend, Mr. Duppa, who had in an eminent degree contributed to whatever success had attended their labours.

The family of organic acids thus attacked, and which is represented by lactic acid, had for some years past excited the interest and attention of chemists, but although much laborious investigation had been expended upon it, especially by Kolbe and Wurtz, yet the constitution of these acids was still far from being established. Like any effort to overcome a difficulty, such an investigation required the selection of a plan of attack, and the preparations of the agents, or weapons, by which the assault was to be made. The speaker had already proved in a paper communicated to the Royal Society, that oxalic acid was the basis or model of the family of acids to be investigated. This fact showed the path by which the subject was to be approached, and he then went on to describe the principles according to which the weapons were constructed.

In Mechanics the engineer proportions the force which he employs to the effect required to be produced, and it was considered one of the greatest achievements in such control of mechanical force when Mr. Nasmyth's steam-hammer could be made, at one moment to deliver a blow gentle enough to break the shell of a nut without crushing the kernel, and at the next to descend with a force sufficient to smash a block of granite and shake the ground beneath it. As in mechanics, where we deal with masses, so in chemistry, where we have to do with atoms, it is also necessary to apply a properly graduated amount of force, and to apply it in the right direction. Chemistry was yet far behind mechanics in this faculty of graduating force, but by availing ourselves of certain chemical reactions, we had the power, as it were, of gradually storing up force in the atoms of bodies, and of delivering the blow when the force had become strong enough to effect the change required. In this way the comparatively inert radicles or molecules, methyl, ethyl, amyl, &c., could be invested with chemical energy sufficient to force their entrance into oxalic acid. The process of thus endowing these radicles with force was likened to the gradual winding up of a weight to the height necessary for the production of a given effect by its subsequent fall. For this purpose a force external to the atoms to be elevated was obviously required. The first supply of this force was taken from sodium; but sodium, although competent to raise the molecules of ethyl or methyl to a great elevation, was yet too rough in the use of its power, for if we attempted by its sole agency to elevate these molecules, they were actually torn to pieces by the violence of the effort. The action of the sodium must, therefore, be moderated by combining it with mercury; much of its power was thus lost, but sufficient still remained for the purpose, if rightly employed.

This sodium amalgam on being brought into contact with the iodides of methyl, ethyl, or amyl, refused to exert any action, but on the addition of a few drops of acetic ether, which acted in this case like a ferment, the sodium separated the iodine from the ethyl, whilst the latter united itself with the mercury.

$$\underbrace{2C_2H_5I}_{\text{Iodide of ethyl}} + \underbrace{Hg\begin{cases}Na\\Na\end{cases}}_{\text{Sodium amalgam}} = \underbrace{Hg\begin{cases}C_2H_5\\C_2H_5\end{cases}}_{\text{Mercuric ethide}} + \underbrace{2NaI}_{\text{Iodide of sodium}}$$

By this association with mercury the energy of the ethyl was greatly increased, but it still lacked sufficient power for its attack upon oxalic acid. Having once commenced its ascent, however, the further elevation of the ethyl became comparatively easy. It was only necessary to digest the mercuric ethide, procured as above described, with metallic zinc at a temperature of 100° C. for several hours, in order to replace the mercury with zinc, by which means zinc ethyl was obtained.

$$\underbrace{Hg\begin{cases}C_2H_5\\C_2H_5\end{cases}}_{\text{Mercuric ethide.}} + Zn. = \underbrace{Zn.\begin{cases}C_2H_5\\C_2H_5\end{cases}}_{\text{Zinc ethyl.}} + Hg.$$

The zinc ethyl thus obtained possessed far greater energy than the mercuric ethide from which it was derived,[*] and, in fact, in this compound the ethyl became fully armed for the contemplated expedition. The speaker, however, showed that its power could be still further increased by the addition of the metal lithium. By these processes the following chemical compounds and weapons of attack had been manufactured :—

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[*] The intense chemical energy of zinc ethyl was shown experimentally by a fountain of the liquid, which played perpendicularly to the height of six or eight feet, forming a fiery jet of blue and white flame.

Name.	Formula.
Mercuric Methide . . .	$Hg\left\{\begin{matrix}CH_3\\CH_3\end{matrix}\right.$
Mercuric Iodo-methide . .	$Hg\left\{\begin{matrix}CH_3\\I\end{matrix}\right.$
Mercuric Ethide . . .	$Hg\left\{\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right.$
Mercuric Iodo-ethide . .	$Hg\left\{\begin{matrix}C_2H_5\\I\end{matrix}\right.$
Mercuric Chlor-ethide . .	$Hg\left\{\begin{matrix}C_2H_5\\Cl\end{matrix}\right.$
Mercuric Amylide . . .	$Hg\left\{\begin{matrix}C_5H_{11}\\C_5H_{11}\end{matrix}\right.$
Mercuric Iod-amylide . .	$Hg\left\{\begin{matrix}C_5H_{11}\\I\end{matrix}\right.$
Mercuric Chlor-amylide . .	$Hg\left\{\begin{matrix}C_5H_{11}\\Cl\end{matrix}\right.$
Zincmethide	$Zn\left\{\begin{matrix}CH_3\\CH_3\end{matrix}\right.$
Zincethide	$Zn\left\{\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right.$
Zincamylide	$Zn\left\{\begin{matrix}C_5H_{11}\\C_5H_{11}\end{matrix}\right.$
Lithio-mercuric Methide .	$\begin{matrix}Hg''\\Li'\end{matrix}\left\{\begin{matrix}CH_3'\\CH_3'\\CH_3'\end{matrix}\right.$?
Lithio-mercuric Ethide . .	$\begin{matrix}Hg''\\Li'\end{matrix}\left\{\begin{matrix}C_2H_5'\\C_2H_5'\\C_2H_5'\end{matrix}\right.$?
Lithio-zinc Methide . .	$\begin{matrix}Zn''\\Li'\end{matrix}\left\{\begin{matrix}CH_3'\\CH_3'\\CH_3'\end{matrix}\right.$?
Lithio-zinc Ethide . . .	$\begin{matrix}Zn''\\Li'\end{matrix}\left\{\begin{matrix}C_2H_5'\\C_2H_5'\\C_2H_5'\end{matrix}\right.$?

The speaker then described the action of several of these bodies upon oxalic acid, or rather oxalic ether. This action consisted in the removal of one atom of oxygen from oxalic acid, and its substitution by two atoms of ethyl, methyl, &c. Thus, by the action of zinc ethyl, oxalic acid was transformed into leucic acid—a body that had previously been obtained from animal tissues, especially from the spleen and lungs. By acting upon oxalic ether with the zinc compounds of other organic radicles, a large number of acids belonging to the lactic series, and hitherto unknown, could be produced. Many of these acids were isomeric with each other, that is, possessed the same percentage composition, but differed in their interior architecture. Thus leucic acid was susceptible of no less than nine isomeric modifications, three of which had already been obtained by the method now described. The following table shows the internal structure of these isomeric leucic acids :—

$C_2'''\left\{\begin{matrix}C_2H_5'\\C_2H_5'\\O''\\OH'\\OH'\end{matrix}\right.$	$C_2'''\left\{\begin{matrix}C_2H_5'\\H'\\O''\\OC_2H_5'\\OH'\end{matrix}\right.$	$C_2'''\left\{\begin{matrix}C_2H_5'\\CH_3'\\O''\\OCH_3'\\OH'\end{matrix}\right.$
$C_2'''\left\{\begin{matrix}CH_3'\\CH_3'\\O''\\OC_2H_5'\\OH'\end{matrix}\right.$	$C_2'''\left\{\begin{matrix}C_3H_7'\\C_3H_7'\\O''\\OH'\\OH'\end{matrix}\right.$	$C_2'''\left\{\begin{matrix}C_3H_7'\\H'\\O''\\OCH_3'\\OH'\end{matrix}\right.$
$C_2'''\left\{\begin{matrix}CH_3'\\H'\\O''\\OC_3H_7'\\OH'\end{matrix}\right.$	$C_2'''\left\{\begin{matrix}C_4H_9'\\H'\\O''\\OH'\\OH'\end{matrix}\right.$	$C_2'''\left\{\begin{matrix}H'\\H'\\O''\\OC_4H_9'\\OH'\end{matrix}\right.$

‘The following is a list of acids which, with their compounds, have thus been produced and investigated during the past year in the laboratory of the Institution :—

Name.	Formula
Dimethyloxalic acid No. 1 .	$C_2'''\left\{\begin{matrix}CH_3'\\CH_3'\\O''\\OH'\\OH'\end{matrix}\right.$
Dimethyloxalic Acid No. 2 .	$C_2'''\left\{\begin{matrix}CH_3'\\H'\\O''\\OCH_3'\\OH'\end{matrix}\right.$
Leucic Acid No. 1 . . .	$C_2'''\left\{\begin{matrix}C_2H_5'\\C_2H_5'\\O''\\OH'\\OH'\end{matrix}\right.$
Leucic Acid No. 2 . . .	$C_2'''\left\{\begin{matrix}C_2H_5'\\CH_3'\\O''\\OCH_3'\\OH'\end{matrix}\right.$
Leucic Acid No. 3 . . .	$C_2'''\left\{\begin{matrix}CH_3'\\CH_3'\\O''\\OC_2H_5'\\OH'\end{matrix}\right.$
Ethyl-amyl Oxalic Acid .	$C_2'''\left\{\begin{matrix}C_5H_{11}'\\C_2H_5'\\O''\\OH'\\OH'\end{matrix}\right.$
Diamyl-oxalic Amyl-ether .	$C_2'''\left\{\begin{matrix}C_5H_{11}'\\C_5H_{11}'\\O''\\OH'\\OC_5H_{11}'\end{matrix}\right.$

These reactions proved that lactic acid, the representative of this family of acids, was also cast in the mould of oxalic acid. Thus, the latter deadly organic body was converted by the removal of one atom of oxygen and its substitution by one of hydrogen and one of methyl into the harmless acid of sour milk, a constituent of the juices of the human body, and an agent, no doubt, of importance in the transformations attending animal life. A similar marvellous transmutation of character is met with in the highly poisonous arsenic acid, which, by the exchange of one atom of oxygen for two of methyl, is converted into the innocuous, though perfectly soluble, cacodylic acid.

The speaker concluded as follows :—Here, then, we have a most prolific reaction, capable of furnishing an immense number of new organic bodies, and at the same time indicating to us the very simple manner in which nature evolves some of her, apparently, most complex results. By a species of progressive development, this simply organised oxalic acid becomes gradually elevated, cultivated, and transformed into bodies, which, when viewed by one ignorant of their true origin, appear to possess a hopeless complexity. Not only do we now gain a clear insight into the architecture of these acids, but we can take the very elements of which they are composed, and build them up unaided by any vital processes. We need not even go for oxalic acid, our very type or model, either to the wood-sorrel, or the lichen, which, by means of this acid, corrodes the rock upon which it grows ; for we have the power both to lay the foundation and to build the superstructure of these organic bodies, without the least assistance from either animal or vegetable life. And is it too much to hope that, by analogous inductive scrutiny, even the most obscure and complex physiological phenomena of life itself will one day yield to scientific research, and become to us as clear and simple as they are now dark and unintelligible? But to accomplish this, the human intellect must prepare itself for efforts far more difficult than any has yet made. Hitherto, the more palpable and simple phenomena of nature have been the first to attract the attention of philosophers, whilst the more recondite and hidden, constituting increasingly difficult subjects of research, have been left for future explorers. Thus, although we are still scarcely advanced beyond the condition of children gathering pebbles on the shore of the boundless ocean of knowledge, yet those pebbles, never easy to find, are now no longer left dry on the beach. They may be dragged from the grip of the waves by patient and cunning toil. Difficulties innumerable and appalling confront us, but let the human intellect be only left free and untrammelled, and it will surely accomplish the task before it.

CANTOR LECTURES.

"On Chemistry Applied to the Arts." By Dr. F. Crace Calvert, F.R.S., F.C.S.

Lecture V.

Delivered on Thursday Evening, May 5, 1864.

(*Continued from page 102.*)

Mi its composition, properties, falsification, and preservation. *Urine* uses. A few words on putrefaction.

M.—The composition of this important fluid varies not y in different classes of animals, but also in fere individuals of the same class. Further, the compo n of milk is modified by the influence of food, cli e, degree of activity, and health. Notwithstanding th variations, an average can be arrived at by numerous an ses, and the following table will give a general idea of lk :—

	Woman's.	Cows'.	Asses'.	Goats'.	Ewes'.
pl Caseine	15.2	44.8	18.2	40.2	45.8
ter	33.5	31.3	1.2	33.2	12.0
ar of milk	65.0	47.7	60.8	52.8	50.0
s	4.5	6.0	3.4	5.8	6.8
ter	881.8	870.2	916.5	868.0	885.4
	1000.0	1000.0	1000.0	1000.0	1000.0

The various substances comprised in milk may be classified under three heads—cream, curd or caseine, and whey.

Cream, according to Dr. Voelcker's* analysis, is composed of :—

Water	61.67	64.80
Butter	33.43	25.40
Caseine	2.62	7.61
Sugar of milk ...	1.56	
Mineral matters ...	0.72	2.19
	100,00	100.00

And may be considered as consisting of small, round, egg-shaped globules, composed of fatty matters, enclosed in a thin cell of caseine, which, being lighter than the fluid containing them, rise to the surface and constitute cream, and in proportion to the quantity of this removed from the milk, the latter becomes less opaque, and assumes a blue tinge. When exposed to the air for a short time in a dry place it loses water, becomes more compact, and constitutes what is called cream cheese. When churned, cream undergoes a complete change; the caseine cells are broken, and the fatty globules gradually adhere one to the other and form a solid fatty mass, called butter, and it is found, on an average, that 28 lbs. of milk will yield 1 lb. of butter. Fresh butter is composed of :—

Fatty matters	Margarine Oleine Caproine Caprine Butyrine Caproleine	77.5
Caseine ...		1.6
Whey		20.9
		100,00

But as butter rapidly becomes rancid, it is necessary to adopt means to prevent this as much as possible, and the following are the usual methods—viz., working the butter well with water, and then adding 3 or 4 per cent. of common salt, or melting the butter at a temperature below 212°; but the following method, employed by M. Bréon, appears to give general satisfaction—It consists in adding to the butter water containing 0.003 of acetic or tartaric acid, and carefully closing the vessels containing it. The rancidity of butter is due to a fermentation generated by the caseine existing in it, which unfolds the fatty matters into their respective acids and glycerine, and as the volatile acids, butyric, caproic, &c., have a most disagreeable taste and odour, it is these which impart to butter the rank taste. Allow me to add, *en passant*, that whilst butyric acid possesses a repulsive smell, its ether has a most fragrant odour—viz., that of pineapple, for which it is sold in commerce.

Curd of Milk or Caseine has, according to Dr. Voelcker, the following composition :—

Carbon	53·57
Hydrogen	7·14
Nitrogen	15·41
Oxygen	22·03
Sulphur	1·11
Phosphorus	0·74
	100·00

And is easily recognisable by its white flocculent appearance. It is insipid and inodorous, like albumen, from which it differs in its insolubility in water, though it is dissolved by a weak solution of alkali or acid. But what chiefly distinguishes caseine is that it is not coagulated on boiling, and that rennet precipitates it from its solutions. Dr. Voelcker has proved, however, in his researches on cheese, that the commonly-received opinion that rennet coagulates milk by decomposing the lactine into lactic acid is incorrect, for he has coagulated milk while in an alkaline condition, and it is owing to the difference in the action of rennet on albumen and caseine that chemists have been able to detect the presence of ½ to ¾ per cent. of albumen in milk. This important organic substance not only exists in milk, but is also found in small quantities in the blood of some animals, such as the ox, and in a large class of plants, but more especially in the leguminous tribe, such as peas, beans, &c. Caseine is the basis of all cheeses, and when these are made with milk from which the cream has been previously taken the cheese is dry, but when part of the cream has been left the cheese is rich in fatty matters as well as in caseine; and I may add that the peculiar flavours characterising different cheeses are caused by modifying the conditions of the fermentations which the organic matters undergo. The following researches made by M. Blondeau illustrate this point, as well as the modifications which cryptogamic life under peculiar circumstances may effect in the composition of organic substances, and his interesting results were obtained in studying the conversion of curd into the well-known cheese of Roquefort. He placed in a cellar some curd of the following composition :—

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* For further particulars on this subject, the reader is referred to Dr Voelcker's paper, published in the *Journal of the Royal Agricultural Society of England*, volume xxiv.

Caseine	85·43
Fatty matters	1·85
Lactic acid	0·88
Water	11·84
	100·00

To which he added a small quantity of salt. After a month, and again after two months, he analysed portions of the same, with the following results:—

	After one month.	After two months.
Caseine	61·33	43·28
Fatty matters	16·12	32·31
Chloride of sodium ...	4·40	4·45
Water	18·15	19·16
Butyric acid	—	0·67
	100·00	99·87

The above figures show a most extraordinary change in the caseine or curd, for we observe that the proportion of caseine gradually decreases, and is replaced by fatty matters. Considering the circumstances under which this phenomenon has occurred, there can be doubt that this curious conversion of an animal matter into a fatty one is due to a cryptogamic vegetation or ferment; and if the Roquefort cheese be exposed to the air under a bell jar for twelve months, the decomposition becomes still more complete; for it is no longer the caseine which undergoes a transformation, but the oleine of the fatty matters. The following analyses clearly illustrate this curious action. Composition of the cheese after two and twelve months:—

	After 2 months.	After 12 months.
Caseine	43·28	40·23
Margarine	18·30	16·85
Oleine	14·00	1·48
Butyric acid	0·67	—
Common salt	4·45	4·45
Water	19·30	15·16
Butyrate of ammonia...	—	5·62
Caproate of ammonia ...	—	7·31
Carprylate of ammonia...	—	4·18
Caprate of ammonia ...	—	4·21
	100·00	99·49

The substances to which cheeses owe their peculiar flavour are ammoniacal salts, chiefly composed of various organic acids, such as acetic, butyric, capric, caproic, and caproleic. I cannot better conclude my remarks on cheese than by extracting from Dr. Voelcker's interesting papers a few of his numerous analyses of different kinds of cheese:—

	Cheshire.	Stilton.	Old Cheddar.	Double Glo'ster.	Single Glo'ster.	American.
Water	32·59	20·27	30·32	32·44	28·10	27·29
Butter	32·51	43·98	35·53	30·17	33·68	35·41
†Caseine	26·06	33·55	28·18	31·75	30·31	25·87
Sugar of milk . . } Lactic acid . . }	4·53		1·66	1·22	3·72	6·21
†Mineral matter . .	4·31	2·20	4·31	4·42	4·19	5·22
	100·00	100·00	100·00	100·00	100·00	100·00
†Nitrogen	4·17	3·89	4·51	5·12	4·85	4·14
†Common salt . . .	1·59	0·29	1·55	1·41	1·92	1·97

The principal application of caseine in arts and manufactures is that first introduced by Mr. R. T. Pattison, who used it under the name of lactarine for fixing pigments in calico printing. His process consists in drying the washed curds of milk, which he sells to the calico printer, who mixes it with a solution of ammonia or weak alkali, which swells it out and renders it soluble in water. To a solution of this substance, of proper consistency, he adds one of the tar colours, prints it, submits the goods to the action of steam, which drives off the ammonia, leaving fixed on the fabric the caseine and colour. In consequence of the insoluble compound which caseine forms with lime it has often been used as a substitute for glue or linseed oil in house painting, and it may be useful to some of my audience to know that when caseine is dissolved in a concentrated solution of borax, an adhesive fluid is formed, which is capable in many cases of serving the purposes of glue or starch. Mr. Wagner has made another useful application of caseine, mixing it with six parts of calcined magnesia and one part of oxide of zinc, and sufficient quantity of water to make a pasty mass, which he leaves to solidify, and when dry it is extremely hard, susceptible of receiving a high polish, and is sold as a substitute for meerschaum.

Whey.—According to Dr. Voelcker, the composition of whey is as follows:—

Water	89
Butter	0
Caseine	3
Sugar of milk	5
Mineral matters	0
	100

When whey is concentrated to the state of syrup and kept in a cold place, it gradually deposits fine, well-defined crystals, which, on further purification and re-crystallisation, yield white quadrangular prisms of a substance called lactine, or sugar of milk, which is highly interesting. It is remarkable that while sugar of milk has only been known in Europe for a comparatively short period, here homœopathists are its principal employers, in India lactine has been known for a great number of years. Let us now study some of the chemical facts connected with sugar of milk. Thus cane sugar, when acted upon by nitric acid, gives oxalic acid, whilst lactine gives mucic acid; cane sugar, when unfolded under the influence of a ferment, gives alcohol and carbonic acid; lactine yields lactic acid. As the latter transformation is most important, in a physiological and chemical point of view, allow me to dwell upon it for a few minutes. The substance which possesses the property of most readily converting lactine into lactic acid is caseine after it has undergone some peculiar modification, which renders it a ferment. Thus when milk leaves the cow it is alkaline, but when exposed to the air it rapidly becomes acid, and this is due to the conversion of lactine into lactic acid, a change most interesting as a chemical fact, since both lactine and lactic acid have the same composition, the only difference being that two equivalents of oxygen and two of hydrogen cease to exist as such in the acid, but may be considered as combined in the form of water with the remaining elements—

$$\text{Lactine } C_{12}H_{12}O_{12} = 2 \text{ Lactic acid } (C_6H_5O_5,HO).$$

M. Pasteur has shown that this lactic fermentation is not merely confined to milk, but that it is a peculiar fermentation, differing from the previous one, which frequently occurs during the decomposition of organic matters, and is due to a distinct ferment of its own; and his researches on lactic fermentation have explained the fact, observed by M. Pelouze, some years since, that when a vegetable substance, such as sugar or starch, was put in contact with chalk or other alkali and an animal substance, lactic fermentation ensued, but until the researches of M. Pasteur, we did not know why sugar and starch in these circumstances should give lactic acid instead of alcohol and carbonic acid, which would be the result of a fermentation produced by yeast. Lactic acid is a most interesting substance to the physiologist, for it is found in large quantities, free or combined with lime, in gastric juice, in the muscular part of animals, or with soda, in blood, and its production is easily accounted for when we remember that it can be produced from the starch and sugar existing in our food. When lactic acid is purified by various chemical means and separated from the fluid in which it is combined, it presents itself as a syrupy fluid, of an intensely acid reaction, which, when submitted to the action of heat, first loses its one equivalent of water, and becomes anhydrous lactic acid, and on a further application of heat loses still one equivalent of water, and is transformed into a neutral substance called lactide. This acid, in a free state, has not yet received any important application in art and manufactures, but I have little doubt that it will some day be largely employed, for we have noticed in a former lecture its advantageous use when produced from rye and other amylaceous substances in removing the lime from various skins intended to be tanned or prepared as there described, and Mr. E. Hunt has used it in the form of sour milk for the conversion of starch into dextrine (see *Journal of the Society of Arts*, December 23, 1859). I wish now to say a few words on the mineral substances existing in whey, and which play a most important part in milk as a nutritious substance. We are all of us too apt to overlook the importance of the mineral elements in food, and to consider as essential the organic matters only. In milk, however, its alkaline salts, and especially the phosphate of lime, are as essential (as food) as caseine or fatty matters, for if an infant requires the lactine to maintain respiration and the heat of the body, the caseine to contribute to the formation of blood, the phosphate of lime is equally essential to the production of bone; permit me here to state that the practice adopted by some mothers of feeding infants upon amylaceous substances, such as arrowroot, sago, tapioca, &c., in place of milk, is most pernicious, for these contain neither flesh nor bone forming element, and milk is the only proper food for infants.

Having now examined the general properties of some of the most important constituents of milk, let us say a few words on that fluid in its integrity. We all know how rapidly milk becomes sour, especially at a temperature of 70° to 90°, and as this is owing, as already explained, to the formation of lactic acid, the best way to preserve milk sweet for domestic purposes is to add to it every day a few grains of carbonate of soda per pint, to keep the milk alkaline. The possibility of preserving milk for a lengthened period has repeatedly occupied the attention of scientific men, as a most important problem to solve for the benefit of persons undergoing long sea-voyages, but up to a recent date with very imperfect success. One of the best plans proposed is to add to milk 7 or 8 per cent. of sugar, and evaporate the whole, agitating all the time to prevent the formation of the skin, and when reduced to one-fifth of its bulk to introduce it into tin cans, which, after being subjected for half an hour to a temperature of 220°, are hermetically sealed. In 1855, l'Abbé Moigno drew the attention of the members of the British Association at Glasgow to milk which he stated contained nothing injurious, and which would keep for a long period. This statement has proved correct, for I have here some milk which has been in the hands of the secretary of this Society since that period, and which, on being opened to day, was found perfectly sweet. But if l'Abbé Moigno's process has remained a secret, M. Pasteur has succeeded in affecting the same end, and probably by the same method. Thus he has found that if milk be heated to 212° it will only remain sweet for a few days, if heated to 220° it will remain sweet for several weeks, but if to 250° (under pressure, of course) the milk will keep for any length of time. This, according to M. Pasteur, is owing to the spores or eggs which generate lactic fermentation being destroyed by the high temperature, and thus the possibility of fermentation is put an end to. The adulteration of milk by various substances stated to have been discovered therein, has, I think, been greatly over-estimated, as I have never found any of them in the samples of milk which I have analysed; in fact, the most easy and cheapest of all is the addition of water. It is comparatively easy to ascertain if milk has been tampered with; but, without entering into details of the methods necessary to estimate the exact extent of adulteration, I may mention the following plan:—If a glass tube, divided into 100 equal parts, is filled with milk and left standing for twenty-four hours, the cream will rise to the upper part of the tube, and, if the milk is genuine, will occupy from 11 to 13 divisions. Another practical method is to add to the milk a little caustic soda, and agitate the whole with a little ether and alcohol, which dissolves the fatty matters; this etherial solution is removed from the milk and evaporated, when the fatty matters remain, and experience has shown that 1000 parts of good milk will yield 37 parts of fatty matters. Any milk leaving no more than 27 must have been tampered with. Dr. Voelcker suggests the employment of a hydrometer as a means of ascertaining the quality of milk, as the specific gravity of that fluid is an excellent test. From a great number of experiments he has ascertained that good new milk has a specific gravity of 1·030, whilst if good milk is adulterated with 20 per cent. of water its specific gravity will fall to 1·025.

Urine is a fluid secreted by the kidneys, which organs separate from the blood as it circulates through them any excess of water it may contain, as well as many organic substances which have fulfilled their vital function in the animal economy, and which require to be removed from the system. The composition of urine varies greatly in different individuals, and in the same individual at different times, and is influenced by diet, exercise, state of health, &c., as shown by Dr. Bence Jones and Dr. Edward Smith, but without detailing these variations, which would occupy far more time than the limits of a lecture would permit, allow me to call your attention to the following table, showing the composition of human and herbivorous animals' urine:—

HUMAN.

Water	933·000
Urea	30·100
Lactic acid	17·140
Lactate of ammonia	
Extractive matter	
Kreatine	
Kreatinine	
Hippuric acid	
Indican	
Colloid acid (W. Marcet) ...	
Uric acid	1·000
Mucus	0·320
Mineral salts	18·440
	1000·000

HORSES.

Water	910·76
Urea	31·00
Hippurate of potash	4·74
Lactate of do.	11·28
Do. of soda	8·81
Bicarbonate of potash	15·50
Carbonate of lime	10·82
Carbonate of magnesia	4·16
Other salts	2·93
	1000·00

The substances in human urine which call for special notice are urea and uric acid; in herbivorous animals, hippuric acid; and in birds, uric acid.

Urea is a substance crystallising in various derivative forms belonging to the prismatic system—it is very soluble in water and alcohol, and gives beautiful and well-defined salts with nitric and oxalic acids. Urea, under the influence of a mucous substance secreted at the same time, and which is easily modified into a ferment, is rapidly converted, by the fixation of two atoms of water, into carbonate of ammonia, as seen by this formula :—

$$\begin{array}{llllll} \text{Urea} & \ldots\quad\ldots\quad\ldots & C_2 & O_2 & N_2 & H_4 \\ \text{Water} & \ldots\quad\ldots\quad\ldots & & O_2 & & H_2 \\ \hline \text{Carbonate of ammonia} & \ldots & C_2 & O_4 & N_2 & H_6 \end{array}$$

This will explain the strong ammoniacal odour arising from urine after being kept for a short time; and as it may be most important for medical men to be able to preserve urine in its normal condition for several days, I observed a few years since a most effectual method of preserving it, which is merely the addition of a few drops of carbolic acid immediately after the production of the urine. Urea is peculiarly interesting to chemists, as it was the first organic substance which they succeeded in producing artificially from mineral compounds. This interesting discovery was made by Wöhler in 1820, in acting upon cyanate of silver by hydrochlorate of ammonia. Since then Baron Liebig has devised a more simple process, which consists in decomposing cyanate of potash by sulphate of ammonia, which gives rise to sulphate of potash and cyanate of ammonia or urea. The average quantity of urea rejected daily by an adult man is about an ounce, or 2½ per cent. of the fluid itself. Although human urine does not contain more than 1 per cent. of uric acid, and this generally combined with soda, still I deem it my duty to say a few words respecting it, for it is often the principal source of gravel and calculus, owing to various influences which make the urine strongly acid before its rejection, whereby the soda is neutralised, the uric acid liberated, and this being nearly insoluble, separates, and has a tendency to form gravel or calculus. In fact, the deposit which occurs in this fluid is generally represented by uric acid, phosphate of lime, and magnesia, mucus, and colouring matter. It may be here stated that calculi were formerly held in great estimation, especially these formed in the intestine, and called bezoards, and this was the case in Eastern countries until very recently. Thus it is related that a Shah of Persia sent to Napoleon the First, among other valuable presents, three bezoards, which were considered to be of great antiquity, and capable of curing all diseases. The urine of birds and reptiles being almost entirely composed of urate of lime, explains why their refuse is of such value as a manure, which arises from its transformation into carbonate of ammonia. When large masses of this refuse undergo a slow and gradual decomposition, as in the dry climate of the Pacific Islands, on the coasts of Peru and Chili, it constitutes guano. It may be interesting to know that in 1835, 6, and 7, a most beautiful colour was prepared from the uric acid contained in guano, and used largely by calico printers and silk dyers under the name of Roman purple, or murexide.*

Before leaving the study of this important animal secretion, let me say a few words on the urina of herbivorous animals. It is generally alkaline, and contains, besides an aromatic principle, an acid discovered by Liebig, and called hippuric acid, together with urea and uric acid, also found in human urine. Hippuric acid is easily obtained in the form of well-defined crystals, by rapidly evaporating the fluid containing it. This acid does not exist in the food of the animal; but benzoic acid, or its homologues, are found there, and during the phenomena of digestion the nitrogenated principles produced by the wear and tear of life fix themselves on the benzoic acid, and convert it into hippuric, as seen by this formula :—

$$\begin{array}{ccc} \text{Benzoic Acid.} & & \text{Hippuric Acid.} \\ C_{14}H_5O_3 + HO & .. & C_{18}H_8O_5N_2 + HO. \end{array}$$

A further proof of the correctness of this view is that when hippuric acid is treated with strong acids or alkali, it transforms itself into benzoic acid, which can be easily extracted.

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* See, for further details, my lecture at this Society, February 5, 1861.

ACADEMY OF SCIENCES.

August 22.

MM. Pelouze and Maurey contributed a long memoir "*On Pyroxyline.*" It contained an account of the different processes employed by the Austrian Government at Hirtenberg, and the French Government at Bouchet, with the relative values of the two products. The superiority of the Austrian cotton, it is said, is shown by its not being spontaneously inflammable, and by the fact that its explosive force can be easily regulated. The authors of this memoir, with some assistants, have experimented in order to ascertain the value of these assertions. They first describe the processes followed at the two manufactories. At Hirtenberg they use a mixture of one volume of monohydrated nitric acid, and three of sulphuric acid, and immerse the cotton for forty-eight hours. At Bouchet a mixture of one of nitric and two of sulphuric acid is employed, and the cotton is immersed for an hour only. The French never use a soluble silicate.

The next point is the yield of cotton. On this the Austrians are silent, but the authors assert that at Bouchet 100 of cotton give 165·25 of gun-cotton. In the laboratory, operating on small quantities, the authors obtained 178.

With regard to the composition, Pelouze, in 1847, announced the composition of pyroxyline to be—

$$C_{24}H_{17}O_{17},5NO_5\,;$$

his most recent experiments lead him to adopt the formula—

$$C_{24}H_{18}O_{18},5NO_5,$$

a formula which involves the increase of 100 of cotton to 177·78. We see above that the authors obtained 178.

The authors next examine the effect of heat on pyroxyline, a point which we may pass over for the present. They next experimented on the projectile force of the two cottons, and found a slight difference in favour of the French.

In conclusion they tell us that although we have learnt something about the mode of production, composition, and chemical properties of gun-cotton, our knowledge of its use in firearms remains in about the same state as it was left by the French commission in 1846.

A lengthened discussion seems to have followed the reading of the memoir, from which we need only quote one remark of General Morin, who said that the Austrians had never communicated their secrets to other Governments, until they had discovered by costly experiments that they were not of the smallest value.

M. Margueritte presented "*A third note on the Theory of Steelification*"—if we may be allowed the word. We need only quote the last paragraph. The truth is, he states, that nobody yet can prove whether steel is a nitro-carbide, a phospho-carbide, a silico-carbide, a mangano-carbide, a chromo-carbide, a titano-carbide, or a tungsto-carbide, &c., &c., of iron. But there is a typical steel, a carbide of iron, which becomes modified by the influence of all the other metals and metalloids which may combine with it.

M. Roux contributed a memoir "*On the Saltness of the Sea,*" from which we can learn nothing.

M. Chautard presented a note "*On the Phenomena observed in Spectro produced by the Spark of an Induction Current in Rarefied Gases.* The author's experiments were undertaken to ascertain the effect of gradually diminishing the intensity of the current.

M. Schlœsing gives yet another process for *the determination of phosphoric acid in earthy phosphates.* This author reduces the acid and volatilises the phosphorus, passing the vapour into a solution of nitrate of silver, and weighing the last, subsequently converting the phosphide into phosphate of silver. He mixes the phosphate with silica, places the mixture in a carbon boat, puts that in a porcelain tube, heats it to a white heat, and passes carbonic oxide. The phosphorus can be estimated by difference, but the author prefers to pass the gases through nitrate of silver, and converting, as we have said, the phosphide into phosphate. We shall give the process at length shortly, and need now only mention further that some red phosphorus condenses in the porcelain tube, and requires to be rinsed out.

M. Michaelson contributed a note "*On Butylic and Propylic Aldehydes.*" Limpricht and Piria have proved that a corresponding aldehyde is formed when formiate of lime is distilled with the lime salt of an acid. The author accordingly tried to obtain butylic aldehyde by distilling a mixture of formiate and butyrate of lime. He did, in fact, obtain it, but found it to be accompanied by propylic aldehyde.

MM. Millon and Commaille presented a note "*On the Analysis of Milk.*" The subject being of much practical interest, and as the paper introduces two new constituents, we shall give it in full. Lactoproteine we noticed in a previous communication of the authors. The odourous principle they separate by means of bisulphide of carbon, which, it seems, does not dissolve the butter, but extracts the perfume of the milk, which is sometimes agreeable and sometimes not, according to the nature of the fodder, the authors say. With regard to colour, they say that the butter of cows' milk is always yellow, but that of goats, sheep, women, and asses is always colourless.

M. Commaille also contributed "*A New Method of Estimating Vegetable Astringent Matters.*" Some vegetable matters decompose iodic acid in the presence of prussic acid, and some do not. Among the former are the astringent matters. Accordingly the author adds to a vegetable decoction, some very weak prussic acid, and a measured quantity of a solution of iodic acid of known strength, and subsequently determines the amount of unchanged iodic acid. One gramme of gallic acid will destroy 2·366 grammes of iodic acid and one gramme of tannin 2·320.

A short note by M. Blondeau "*On the Action of Ammonia on Starch*" makes known the fact that the two placed in contact give rise to a compound which represents an equivalent of each in combination. It is a weak base to which the author has given the name *amidiaque.* Guided by analogy, we suppose *we* ought to call it *amidia.*

NOTICES OF BOOKS.

Poggendorf's Annalen der Physik und Chemie.
August, 1864.

This journal opens with a long and valuable paper "*On the Spectra of the Flames of Various Gases,*" by Dr. Dihbits. It includes observations made on the flame of hydrogen burnt in air, in oxygen, nitrous and nitric oxide, and in chlorine; and also of carbonic oxide and cyanogen burnt in air, oxygen, and nitrous oxide. The flames of ammonia, sulphuretted hydrogen, and of some other gases are also examined under various conditions, the whole forming a most valuable contribution to our knowledge of the subject. A curious fact, discovered by the author, is that a solution of sulphate of quinine does *not* fluoresce with the light of the flame from hydrogen, hydrocarbons, and ammonia, but does with the flames of carbonic oxide, cyanogen, sulphur, and, indeed, all sulphur compounds. When fluorescence does take place it is always strongest with the flame in oxygen. Another valuable paper is by Landolt, "*On the Influence of the Atomic Constitution of Volatile Compounds of C, H, and O on the Propagation of Light.*" Other papers interesting to chemists are one by Krönig, "*On the Series of Weights most convenient for Laboratory Use, with Hints on Weighing;*" another by Rammelsberg, "*On the Crystalline Form of Bromide of Barium.*" A description of "*A New Saccharimeter,*" by H. Wilde. Dr. Carl Bischof gives "*A Preliminary Notice of a New Earth,*" which he has discovered in a lime mineral. The most distinctive peculiarities of this earth appear to be that it forms a volatilisable chloride and a hydrated oxide, which is soluble in water; it gives no peculiar blow-pipe reactions, and shows nothing in the spectroscope. We shall hear more of this earth when the author has a larger quantity to experiment with. It is hardly necessary to say that, as usual, Poggendorff contains various papers on Physics of great value to advanced readers.

Annalen der Chemie und Pharmacie. August, 1864.

The first paper is by Than, "*On the Anomalous Vapour of Sal Ammoniac.*" As it bears on the discussion recently noticed in M. Wurtz's lectures, we shall devote some space to the subject on a future occasion. At present we need only say that the author confirms the views of Wanklyn and Robinson, and disagrees with Deville. Kammerer and Carius have a paper "*On a New Class of Organic Acids,*" the names of which will indicate the nature—Benzo-sulphuric, aceto-sulphuric, and succino-sulphuric acids—the mode of formation, constitution, and some of the salts of these are described. Another paper by Carius is "*On the Isomerism of Aldehyd with the Oxides of Polyequivalent Alcohol Radicals.*" Kekulé contributes two papers, one "*On the Action of Hydriodic Acid on Iodine Substitution Products,*" and the other "*On the Action of Hydriodic Acid on Polyatomic Acids.*" Dr. Stude gives a further account of "*Everniin,*" a glucogenous substance he obtained from *Evernia Prunastri,* and also of pectin and another new glucogenous substance which appears to be combined with pectin. Three short papers conclude a very interesting number of this journal. The titles of these are —"*On the Action of Phenylic Acid and Aniline on Urea,*" by Baeyer; "*On a Compound of Cyanamid with Aldehyd,*" by C. A. Knap; and "*On the Inversion of the Absorption-bands of the Didymium Spectrum,*" by Bunsen.

Zeitschrift für Chemie und Pharmacie. Heft 16, 1864.

A notice of most of the papers in this number has already appeared in the Chemical News from their original sources; but the first "*On the Action of Sodium Amalgam on Nitrotoluol,*" by Werigo, deserves mention, since the author is anxious to reserve the investigation. By the above action the author has obtained a body which crystallises from hot alcohol in silky needles of a reddish-yellow colour, and which fuse at 100° to a reddish liquid. With bromine they yield a sublimable product. Cymol has been treated in a similar way, but the results are not given. In a paper "*On the Molecular Weight of Subchloride of Mercury,*" Dr. Erlenmeyer confirms the fact mentioned recently by Dr. Odling, that in a state of vapour calomel splits up into Hg and $HgCl_2$.

NOTICES OF PATENTS.

Relating to the Production of Coal-tar Colours.

(*Continued from page 272.*)

475. *Improvements in the Treatment of Colouring Matters derived from Tar, for the purpose of making them applicable for Painting.* E. T. Huonas, Chancery Lane, London. A communication. Dated February 21, 1863.

In order to prepare cakes of red, blue, violet, and other colours for painting, the inventor combines the well-known pigments derived from coal-tar with soap and alumina, or sulphate of baryta, in a moist state. The proportions may be varied, but the following are said to succeed: 150 parts of white curd soap are dissolved in 1000 parts of hot water, and then mixed with the solution, in alcohol or methylated spirit, of 6 parts of the crystallised or solid coal-tar pigment. To this mixture is then added 250 parts by weight of gelatinous alumina, the whole well stirred, and the product collected on a filter, drained, and afterwards divided into cakes and dried.

If it be required to obtain colours which are soluble in water or oils, the inventor employs the soap alone in combination with a suitable colouring matter, and these may be very considerably modified by admixture; thus, he prepares a fine yellow cake from picric acid, or the picrate of lead, or from the compounds of this substance with earthy bases. This product may then furnish a green colour by admixture with aniline blue, or an orange tint by being combined with one of the red pigments derived from coal-tar. These colours are stated to possess the qualities of brilliancy and permanence, and to be available for many purposes in the arts.

660. *Making Dyes from Aniline and its Analogues.* R. T. Monteith, St. Malo, France, and R. Monteith, Manchester. A communication. Dated March 11, 1863.

The inventors procure two distinct shades of brown, both of which are suitable for dyeing, by acting upon magenta or aniline red with a salt of aniline, at a temperature of about 390° Fahr., and in a vessel which may either be open or closed. From one to six hours is an ordinary period for continuing the application of heat, and the brown mass resulting is treated first with boiling water to remove that portion which is soluble, and the remainder is afterwards dissolved in alcohol or methylated spirit to furnish a solution, which is well fitted for dyeing yarns or textile fabrics of a rich brown colour.

717. *Manufacture of Brown Colouring Matters.* G. De Laire, Paris. A communication. Dated March 17, 1863.

This invention differs from the foregoing by specifying the employment of *blue* or *violet* dyes (instead of magenta) in conjunction with a salt of aniline—by preference the hydrochlorate—which mixture is heated for the purpose of forming the brown dyes.

700. *Colouring Matters for Dyeing and Printing.* W. Boaler, Manchester. A communication. Dated March 14, 1863. (Not proceeded with.)

This claim refers generally to the employment of gases, as generated by the chemical action of acids upon metals, for the purpose of effecting the conversion of aniline or its homologues into useful colouring matters by partial oxidation.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1880. Elizabeth Brimson, Frome, Somersetshire, "Improvements in envelopes or covers for bottles and jars."—Petition recorded July 28, 1864.

1913. Henry Carter, Camberwell New Road, Surrey, "Improvements in the manufacture of green colouring matters to be used in dyeing and printing."—Petition recorded August 1, 1864.

1916. Frederick Daniel Delf, Liverpool, Lancashire, "An improved apparatus for coating fabrics or materials with medical or other compounds, also applicable for ironing purposes."

1920. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of glazes or enamels for pottery ware."—A communication from Dominique Grosjeau, Cosseneu, near La Motte Beuvron, France."—Petitions recorded August 2, 1864.

1963. Niel McHaffie, Broad Street, Glasgow, "Improvements in treating iron plates for shipbuilding, boiler making, and similar uses, and also wrought iron in other forms, to render it capable of resisting oxidation or destruction by sea and other water, and atmospheric and other corroding influences."—Petition recorded August 6, 1864.

1496. Thomas James Hughes, Albany Street, Middlesex, and William Henry Hotten, Hope Street, Hackney, Middlesex, "An improved composition to be used for coating surfaces, and insulating metal from metal."—Petition recorded June 16, 1864.

1570. Alexander Hett, London, and Frederick William Bassett, Camberwell, Surrey, "Improvements in preserving animal and other substances."—Petition recorded June 23, 1864.

1602. Charles Denis, Arras, France, "Improvements in gas-heating or cooking-stoves."—Petition recorded July 25, 1864.

1937. Bernard O'Connor, Manchester, Lancashire, "An improved method of making non-inflammable plain and twilled dyed cotton fabrics, called jeannetts, beetle-twills, rolled shirtings, fancy and striped and spotted shirtings, and other cotton goods, printed or otherwise, used for lining dresses and making crinolines."

1950. Giacomo Felice Marchisio, Baker Street, Middlesex, "An improved apparatus for generating inflammable air for illuminating and heating purposes, and supplying the same to the burners."—Petitions recorded August 4, 1864.

1962. Charles Bartley, Blackheath, Kent, "Improvements in compositions for preventing the bottoms of iron ships from fouling or corroding."—Petition recorded August 6, 1864.

1988. Henry Armistead, Ovenden, near Halifax, Yorkshire, "Improvements in dyeing and sizeing or preparing warps for weaving."

1989. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in gilding glass and vitreous surfaces."—A communication from Edouard Dodé, Paris, France.

1994. Charles Lowe, South Bradford, near Manchester, Lancashire, "Improvements in the manufacture of colouring matters."—Petitions recorded August 10, 1864.

2029. Siegmund Moore, Liverpool Street, London, "Improvements in electro gilding."

2033. Edmund Alfred Pontifex, Shoe Lane, London, "Improvements in treating stick lac when manufacturing shell lac and lac dye."—A communication from Thomas Frederick Henley, Boulevard Malesherbes, Paris, France.—Petitions recorded August 15, 1864.

Notices to Proceed.

964. John Riley, Hapton, near Accrington, Lancashire, "An improved sizing substance."—Petition recorded April 16, 1864.

974. George Davies, Serle Street, Middlesex, "An improved respiratory apparatus."—A communication from Albert Galibert, Paris.—Petition recorded April 18, 1864.

1012. George Davies, Serle Street, Middlesex, "Improvements in inhaling apparatus."—A communication from Emile Siegle, Stuttgard, Wurtemburg.—Petition recorded April 22, 1864.

1060. Richard Archibald Brooman, Fleet Street, London, "Improvements in producing photographic pictures photogenically indelible."—A communication from Charles Raphael Maréchal, junior, and Cyprien Marie Tessié du Motay, Metz, France.—Petition recorded April 27, 1864.

1913. Henry Carter, Camberwell New Road, Surrey, "Improvements in the manufacture of green colouring matters to be used in dyeing and printing.—Petition recorded August 1, 1864.

A Cheap Carpet.—We read in "Cosmos" a letter from M. Duchesne Thoreau relating to a pattern taken from a large *tapis* entirely due to the work of a group of spiders in a state of captivity. He expresses his belief that it is quite possible to produce by the aid of such auxiliaries, and without expense, soft and warm carpets; to arrive at which results it would only be necessary to dispose of a number of working spiders, and over a space proportionate to the magnitude of the work desired.—*Chronicles of Zoology*, "*Quarterly Journal of Science*."

CORRESPONDENCE.

Continental Science.

Paris, August 30.

Some interesting statistics have lately been published touching the sugar manufacture of France. The annual production of sugar from beet-root last year amounted to 190 millions of kilogrammes (about 3,700,000 cwts.), made in 380 different manufactories. The number of beets calculated to produce this quantity is estimated at 2532 millions. According to official figures, Great Britain, with a much smaller population than France, entered for home consumption during the year 1863 no less than 11,000,000 cwt. of the same commodity, from which it follows that the Englishman "with fair round belly" consumes between three and four times as much as the thin Frenchman. What a triumph for Bantingism!

Dr. Wiederhold has lately published a rum test, which any of your readers who are fond of that liquor have an excellent opportunity of trying in London at least. Pour 6 drops of sulphuric acid into 20 drops of the suspected liquor. Effervescence takes place, and the sham spirit loses the characteristic aroma which is retained by the genuine article.

There is a story going about here which I repeat to you as it was told to me, in order that, if not true, it may be contradicted by some of your readers, who are better informed as to dates than myself. It is to the effect that Graham is not the discoverer of dialysis, and is as follows:—On April 1, 1854, M. Dubrunfant (whose writings are familiar to most readers of French scientific literature) took out a patent for certain improvements in sugar refining, in the specification of which he declares, first, that when water and molasses are placed in a vessel separated only by an animal membrane, a weak current is set up between the two liquids; and, secondly, that the water carries with it the salts contained in the molasses that by their presence prevent the sugar from crystallising. Graham's celebrated Bakerian lectures on the Osmotic Force, in which he first explained the dialytic action of membranes, was not delivered until June 15 of the same year. The patent was subsequently rendered useless by the discovery of the method of refining sugar by means of baryta. M. Dubrunfant has, however, lately (June, 1863) patented a refining apparatus on the dialytic principle, in which the septa are made of parchmentised paper. An experimental apparatus has been fitted up at the refinery of Courrieres, near Valenciennes. In this apparatus not only are the salts separated from the sugars by dialysis, but the same means are adopted for separating the nitrate of potash contained in them from the other salts.

A large number of eminent scientific men were made commanders, officers, and chevaliers of the Legion of Honour on the occasion of the Emperor's *fête*. Amongst them figures your colleague, the learned Abbé Moigno, editor of *Les Mondes*, who has received a well-merited chevalier's cross.

The comet discovered some time since has proved more disappointing to the Parisian *comitophopers* than that of M. Tempel. Owing to the feebleness of its light and the haste it is making to keep up with the sun, the best telescopes fail in making it out distinctly. It seems too bad, after having been tortured as we have been from the intense heat, that we should not have at least one good comet to comfort us for our sufferings.

M. Gautier-Lacroze, of Clermont-Ferrand, has been investigating the exact composition of the alunite of Mont Dore. It occurs in a vein measuring 100 metres in length by 50 to 60 in width, and is almost as hard as quartz. It is greyish-white, and its fracture is conchoidal. It contains numerous particles of sulphur distributed through its mass, which may be extracted with bisulphide of carbon. From a kilogramme M. Gautier-Lacroze obtained 73½ grammes of pure sulphur. Crystals of iron pyrites are also found in it. Its specific gravity is 2·481, and its chemical composition varies slightly. It generally contains about 5 per cent of potash, 25 per cent. of sulphuric acid, and 23 per cent. of alumina, the rest being water, silica, sulphur, and oxide of iron. Hitherto, all efforts to use the Mont Dore alunite have failed, in consequence of the difficulty of pulverising the material; but M. Gautier-Lacroze finds that by roasting the alunite becomes sufficiently friable to work easily.

M. Anthon, of Prague, has devised a means of obtaining sulphate of soda from salt by mixing equivalent quantities of sulphate of lime (gypsum), chloride of sodium, and calcined magnesia, with six or eight times the weight of the salt of water. Through this mixture is passed a current of carbonic acid, which transforms the calcined magnesia into the carbonate. The carbonate reacts on the sulphate of lime, forming carbonate of lime and sulphate of magnesia, the latter salt and the chloride of sodium being decomposed into sulphate of soda and chloride of magnesium. The carbonate of lime is separated by filtration, and the sulphate of soda crystallises out, leaving the chloride of magnesium in the mother liquor. The chloride of magnesium may be evaporated, calcined, and used over again.

Paris has just followed in the footsteps of London in reducing the price of metropolitan telegrams. You can now send a message to any part of Paris for fifty centimes, and the telegraphic administration guarantee that it shall be delivered within half-an-hour from the time it is dispatched.

An invention for printing by a dry process has just been patented here by M. Lebouger. Between the type and the paper is inserted a sheet of manifold paper prepared with lamp-black and glycerin, by means of which the impression is made. It would be interesting to try if a number of impressions could be got with one pull of the press by the interposition of several pieces of prepared paper, as in the ordinary method of manifold writing.

The opinion entertained by Gerhardt, Berthelot, and others, that cholesterin was an alcohol, has received experimental confirmation in the hands of M. Lindenmeyer, who has succeeded in forming the ether. This chemist has also discovered cholesterin in notable proportions in peas, beans, almonds, and other vegetable substances containing large quantities of albumen.

M. Hahn has been investigating the hydrocarbons left after the solution of cast-iron in acids. He finds them to consist of a mixture of œnanthylene, caprylene, cetene, and others of the series C_nH_{2n}. These products, I believe, have already been investigated in England in Dr. Percy's laboratory, but I am not aware that the results have been published.

M. Wiederhold has devised a new method of obtaining a brown dye for wool. Peroxide of manganese in fine powder is mixed with dry nitrate of soda and heated to bright redness in a wood furnace. The brownish product obtained is dissolved in water and forms a green solution containing acid manganate of soda (chameleon mineral), which gradually becomes red. When wool is steeped in this red liquor the permanganate of soda becomes decomposed, peroxide of manganese being dissolved in the pores of the fibrous tissue. The colour obtained is stated to stand well against the effects of air and light.

A Suggestion.

To the Editor of the Chemical News.

Sir,—Being an earnest advocate for the new atomic weights, I shall feel obliged if you will allow the following suggestion to be published:—

At the approaching meeting of the British Association, why cannot the whole question of doubling the atomic weights be discussed in the chemical section, the vote of those present taken, and HO be banished for ever from good society, if, as is most probable, the meeting be in favour of 16 as the atomic weight of oxygen?

I am, &c. F.C.S.

August 25, 1864.

Schwartz's Process for Purifying Sugar.

To the Editor of the Chemical News.

Sir,—I read with much pleasure in your valuable paper (page 92, vol. x.) the specification of a patent for separating sugar from molasses. Permit me to make the following remarks. Many more I could make, but I do not wish to trespass too much on your space.

The use of a mixture of acetic acid, which is decidedly the only fit acid for this purpose, and alcohol is by no means new, for as early as 1849 it was tried for a while on the large scale in some beetroot sugar works in Belgium; but, as might be expected, it did not answer practically for many reasons, among which stands foremost the inflammability of the alcohol, which, moreover, owing to the high temperature which prevails in the sugar refineries, most rapidly evaporates. The idea of separating by centrifugal machines the masses dissolved in alcohol and acetic acid from the sugar is apparently good; but the patentee does not seem to have provided for the construction of centrifugal machines fit to withstand the action of acetic acid; for, even though sugar be present, that acid will not fail to act upon the brass and iron ordinarily used in the construction of centrifugal machines. Evidently Dr. Schwartz has not much practical knowledge of the sugar manufacture and refining; his idea also of recovering the alcohol by passing the air charged with volatilised spirit through or over water is quite impracticable. In one word, the specification abounds in incongruities, and, moreover, will not, as one should expect at first, deprive raw sugar at once of all the uncrystallisable sugar, only leaving all the crystallisable in the centrifugal machine[*]—*i.e.*, in the interior revolving cylinder thereof. Instead of lime, as mentioned, baryta might be more profitably used, as is actually done in many beet-root sugar manufactories. The idea of applying strong alcohol (95 per cent. at least) for the refining of sugar is no new one; but its use was only applied on a limited scale, solely to drain the sugar from the unavoidably adhering syrup (uncrystallisable sugar), in the process of the *clairsage*, as it is called with a French term, and the ordinary processes of refining could not entirely be dispensed with. It is curious to read in the specification as something new the use of the mixture of acetic acid and alcohol for determining the percentage of real—*i.e.*, crystallisable—sugar met with in any sample of raw sugar. Fifteen years ago this mixture was in constant use in many Continental refineries and beetroot sugar works—(so at least in Belgium, Northern France, and in Holland; Silesia, of which Breslau is the metropolis, is a country where both sugar manufacture—from beet-root—and refining is largely carried on, and it is almost certain that many years ago the same mixture was applied there for the identical purpose)—where the optical sugar test by Soleil's or other similar apparatus was also applied at the same time. It ought to be borne in mind that both the alcohol and acetic acid must be absolute for this purpose.

The practical refiners of sugar know very well that, by means of the centrifugal machine and the application of a strong, quite concentrated solution of best refined sugar, raw sugar may be entirely freed from the molasses adhering to it; while, owing to the use of a concentrated solution of sugar, nothing but the uncrystallisable sugar is removed, the solution of sugar ~~is~~ being concentrated as to refuse taking up any more crystallisable sugar.

I am, &c., Dr. A. Adriani.

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[*] See page 92, column 2, line 27 from the top.

Numerical Relations of Equivalent Numbers.

To the Editor of the Chemical News.

Sir,—"Few would call chemistry a mathematical science" (*vide* letter by "Studiosus," p. 95 of the Chemical News); and, therefore, I protest against the use of the term "law" when applied to a few cases of mathematical relation between atomic numbers. If there really be such a law as the "law of 'Studiosus'" (how it sounds!)—viz., that the atomic numbers are multiples of 8—then the agreements should be many and the exceptions few. But is not the reverse the case rather? In proof of his law, "Studiosus" enumerates fifteen elements whose atomic numbers are exact multiples of 8. But how many elements are there whose atomic numbers are not multiples of 8? Of sixty-one atomic numbers, seventeen approximate within two units to exact multiples of 8, and thirty cannot by any twisting be called multiples of 8 more than of any other number. So that, to prove this law, fifteen cases out of sixty are adduced, the remaining forty-five being exceptions.

"Studiosus," in his first moments of pardonable ecstasy at having discovered a "law," does not appear to have perceived this disproportion between agreements and exceptions. Subsequent reflection, however, convinced him that he must trim some of the forty-five exceptional numbers in order to make them tally with his "law." Certainly it is necessary at times to make a sacrifice in the cause of law and order; but only fancy (Cl) 35·5 being reduced to 32 as the nearest multiple of 8; (N) 14 being raised to 16, Fl (19) having 5 added, or (As) 75 diminished by 3. "Studiosus" seems to defend this wholesale system of alterations on the ground that these poor wretches of atomic numbers are "merely the result of experiment," and therefore some "amount of latitude" must be allowed. Certainly, "latitude" must be allowed with a vengeance if the numbers above quoted and others are to be forced into obedience to this "law." I wonder what would be the result of using "Studiosus'" lawful numbers in analysis, instead of those derived from actual experiment!

"Studiosus" complains, though unjustly, when Mr. Newlands shows, at p. 59, that there is no such law at all. It is only fair, however, to point out that what ought to be condemned, and what Mr. Newlands himself does condemn—viz., approximations and allowances—are just the means which Mr. Newlands, to a large extent, employs in his own tables of "relations," or how else could he make (p. 59) Zn_{65} a mean between Mg_{24} and Cd_{112}, or V_{137} a mean between Mo_{96} and W_{184}?

The fact is, there has been a great deal of nonsense written about these "laws" and "relations." (But then you know, Mr. Editor, it is much easier to sit down and make laws for these numbers than to verify the numbers themselves.) Of course it cannot be denied that some of the relations which have been pointed out are interesting enough, but in many cases they are mere rubbish. Given 70 numbers ranging from 1 to 240, and allowing any amount of "latitude," to find a law with these conditions, who couldn't discover a law as good as the "law of 'Studiosus?'"—I am, &c. J. Noble, F.C.S.

Royal Arsenal General School, Woolwich, August 30.

ANSWERS TO CORRESPONDENTS.

A. O. Z.—They could not be removed by chemical means. They must be rubbed down.

O. H. A.—See front advertisement page.

C. R.—By adding an alkaline carbonate, unless it is present in the form of carbonate, in which case oxalate of ammonia. The "cheapest" method need not be considered.

R. S.—The detention and estimation of humic acid in water is a very difficult matter. It is supposed to exist in combination with an alkali, and is precipitated on the addition of an acid. You will find a short account of the process in Noad's "Chemical Manipulation and Analysis."

Received.—Dr. Muspratt, with thanks.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Decomposition of Uric Acid by Bromine, and the Action of Heat on Alloxan, by M. E. Hardy.

Uric acid treated by bromine gives no product of substitution, even by operating under pressure. Submitted to a temperature of 180° in sealed tubes, it is partially destroyed, and disengages a considerable quantity of hydrobromic acid.

In presence of water the reacting substances disappear without residue or development of gas; it suffices to pour an excess of bromine on a mixture of uric acid and water to obtain in a few instants a limpid solution, coloured yellow by excess of bromine. The temperature of the mixture rises, and if it is maintained within the proper limits the water decomposes, the hydrogen forms with bromine hydrobromic acid, and the oxygen causes the uric acid to undergo some simple phenomena of oxidation, which cause the formation of alloxan and urea only.

$$\underset{\text{Uric acid.}}{C_{10}H_4N_4O_6} + 2Br + 2H_2O_2 = \underset{\text{Alloxan.}}{C_8H_2N_2O_8} + \underset{\text{Urea.}}{C_2H_4N_2O_2} + 2HBr.$$

By a regulated evaporation crystals of alloxan are obtained, reddening in the air, and containing 2 or 8 equivalents of water, according as they are produced by cooling or by spontaneous evaporation.

More complex phenomena of oxidation take place if the temperature is raised during the reaction. On evaporating, the alloxan is first separated, and then a powder is deposited. This powder is a mixture of bromide of ammonium and of two bodies differing in their solubility in ether. Purified by sufficient crystallisations, the one, insoluble in ether, reproduces the characteristic reactions and the numbers which correspond to composition of parabanic acid—$C_6H_2N_2O_6$; the other, soluble in ether, is oxalic acid—$C_4H_2O_8$.

Uric acid treated under similar conditions by iodine is also transformed in alloxan and urea, but the reaction does not take place at the ordinary temperature, a slight elevation being necessary; the proper limit is, however, easily passed, in which case a mixture of more complex products is obtained.

Chlorine behaves in the same way: alloxan and urea are obtained, provided only that the liquid is not allowed to become heated.

The action of haloid bodies on uric acid held in suspension in water may then be compared to that produced by nitric acid in the process usually employed in the preparation of alloxan, and consists in a simple phenomenon of oxidation, leading, in fact, to exactly similar results.

Alloxan heated to 160° in a current of dry air loses 2 equivalents of water, and becomes anhydrous alloxan —$C_8H_2N_2O_8$. In presence of bases it combines with 2 equivalents of water, and forms alloxanic acid. The latter acid is bibasic, and causes the formation of a series of well-defined white salts. Those hitherto described are white and colourless.

If, on the contrary, alloxan is heated to 260°,—at which point it begins to soften and fuse,—it still loses 2 equivalents of water, and presents the composition of anhydrous alloxan, but then possessing the peculiar property of yielding colourless solutions.

Alloxan thus modified is a brick-red powder, soluble without residue in water, to which it gives a somewhat intense red tint. Left to itself in the open air, it recovers the water it had lost, and quickly loses its colour.

Treated by bases, modified alloxan fixes two equivalents of water, and forms an acid with composition identical with that of alloxanic acid, but differing from it in the property of forming coloured salts, some of which are remarkable for the intensity and richness of their tint. From its being isomeric with alloxanic acid, I call it *iso-alloxanic* acid.

Iso-alloxanic acid cannot be obtained free, it is transformed into a colourless compound by any attempt at isolation.

Iso-alloxanate of Ammonia.—Modified alloxan fused and projected into cold, concentrated ammonia, produces an intense bluish red solution, and on cooling forms a mass. The precipitate collected on a filter and dried is in the form of a red powder. When the ammoniacal solution is dilute, the mere addition of alcohol suffices to produce the same red precipitate.

Iso-alloxanate of ammonia is insoluble in alcohol and in ether, soluble in water, to which it imparts a dark tinge—a very small quantity of matter sufficing to colour a considerable volume of water. This substance does not alter in the open air, but heated with water rapidly loses its colour.

Analysis.

	I.	II.	III.	IV.	V.	VI.		
Carbon .	24·7	24·2	24·3	24·9	,,	,,	C_8	24·7
Hydrogen	4·5	,,	5·1	5·0	,,	,,	H_{10}	5·1
Nitrogen .	,,	,,	,,	,,	29·1	28·8	N_4	28·8
Oxygen .	,,	,,	,,	,,	,,	,,	O_{10}	41·4

These figures lead to the formula—

$$C_8H_2(NH_4)_2N_2O_{10}.$$

Iso-alloxanate of Potash.—A solution of potash with modified alloxan takes a very intense indigo tint, which excess of water turns to violet. The blue salt is precipitated by alcohol, water readily dissolves it.

Acid Iso-alloxanate of Silver.—Modified alloxan dissolved in cold water immediately precipitates a red powder by nitrate of silver. The supernatant liquid remains much coloured, and upon the addition of alcohol deposits the greater part of the salt remaining in solution. Iso-alloxanate of silver is a beautiful dark-red powder, soluble in excess of water, little soluble in alcohol.

Analysis.

	I.	II.	III.		
Carbon. . . .	17·5	,,	,,	C_8	18·0
Hydrogen. . .	2·1	,,	,,	H_3	1·5
Nitrogen . . .	,,	11·8	,,	N_2	10·5
Silver . . .	,,	,,	40·5	Ag	40·5
Oxygen . . .	,,	,,	,,	O_{10}	29·5

These figures correspond to the formula: $C_8H_3AgN_2O_{10}$.

Double salts of ammonia and various other bases are very easily obtained by means of iso-alloxanate of ammonia. These salts are all colourless.

Iso-alloxanate of Ammonia and Silver.—This salt is prepared by precipitating an ammoniacal solution of iso-alloxanate of ammonia by nitrate of silver, the addition of alcohol completes the precipitation. This salt is blue, and very little soluble in alcohol.

Analysis.

Carbon . . .	17·5	,,	,,	C_8	16·9
Hydrogen . . .	,,	,,	,,	H_6	2·1
Nitrogen . . .	,,	14·8	,,	N_3	14·5
Silver . . .	,,	,,	37·9	Ag	37·2
Oxygen . . .	,,	,,	,,	O_{10}	29·3

Hence the formula—$C_8H_2(NH_4)AgN_2O_{10}$.

Iso-alloxanates of ammonia and strontia, ammonia and lime, ammonia and baryta, lead, and mercury are also coloured precipitates. Double salts similar to the above are prepared by replacing the ammonia by potash or soda.

The above compounds, and the preparation of salts derived from a well-defined compound, place beyond doubt the existence of an iso-alloxanic acid isomerous with alloxanic acid, so as to establish the following parallel series:—

Alloxan $C_8H_2N_2O_8$	Modified alloxan $C_8H_2N_2O_8$
Alloxanic acid $C_8H_4N_2O_{10}$	Iso-alloxanic acid—(?)
Alloxanate of ammonia, colourless salt— $C_8H_2(NH_4)_2N_2O_{10}$	Iso-alloxanate of ammonia, red precipitate— $C_8H_3(NH_4)_2N_2O_{10}$
Alloxanate of silver, white salt— $C_8H_2Ag_2N_2O_{10}$	Iso-alloxanate of silver, red precipitate— $C_8H_3AgN_2O_{10}$
Alloxanate of ammonia and silver—(?)	Iso-alloxanate of ammonia and silver, blue precipitate— $C_8H_2(NH_4)AgN_2O_{10}$.

The study of these various compounds gives the true explanation of the reaction which distinguishes uric acid. We know that by evaporating this acid to dryness with nitric acid, we obtain by dessication a red colour which increases by the addition of a few drops of ammonia, and giving the reaction characteristic of uric acid. This colour is considered to result from the formation of murexide or purpurate of ammonia. The foregoing researches prove that this coloration is due, first and principally to red, modified, anhydrous alloxan, then, after the addition of ammonia, to iso-alloxanate of ammonia. —*Bulletin de la Société Chimique*, vi., 445.

The Action of the Amalgam of Sodium on Alkaline Nitrates and Nitrites in Solution, by M. P. DE WILDE.

THE amalgam of potassium was for the first time employed in organic chemistry by M. Melsens, to effect the transformation of trichloracetic into acetic acid.

The amalgam of sodium has since been advantageously substituted for that of potassium, and Melsens's reaction has proved to be remarkable for the generality of its application. In fact, most of the bodies in which chlorine or bromine have been substituted are regenerated by the action of this energetic reducer.

Some recent remarkable studies in organic chemistry have shown that the amalgam of sodium could also provoke direct additions of hydrogen.

It is to be regretted that this agent, which has furnished such admirable results in the hands of MM. Kekulé, Würtz, Lourenço, and others, has as yet been used in mineral chemistry only for the production of the amalgam of ammonium.

Guided by this thought, and by the possibility already proved of transforming nitric acid into ammonia by nascent hydrogen, I tried the action of the sodium amalgam on nitrates and alkaline nitrites.

The amalgam used in my experiments contained from 3 to 4 per cent. of sodium. It is in the form of hard, brittle cakes, which are kept from contact with air.

By putting fragments of this amalgam in cold saturated solutions of nitrate of potash or soda, a violent disengagement of gas takes place, lasting but a few seconds, the temperature rising considerably. The experiment is easily made in a glass funnel with the end sealed, the gases directly collected in receivers reversed in the liquid.

The same phenomena are observable when these solutions are diluted with twenty times their volume of water; likewise when concentrated or diluted solutions of nitrite of potash are used.

In all the instances quoted the quantity of ammonia formed is very minute. Searching for this body with all possible care, we were unable to prove its presence in concentrated solutions; diluted solutions contain hardly a trace.

By pouring sulphuric acid into the solution of a nitrate treated by the amalgam, nitrous vapours are disengaged, which shows that a part of the nitrate has been transformed into nitrite.

With the amalgam of sodium the solution of nitrate of ammonia behaves in the same way as the nitrates and nitrites of potash and soda. No amalgam of ammonium is produced; the gaseous disengagement is very intense; an ammoniacal odour is developed, evidently due to the action of the soda in the undecomposed nitrate, and the ammonia of the nitrate decomposed.

Experimenting under special conditions—that is to say, by putting an excess of amalgam in contact with an alkaline nitrate or nitrite—a notable quantity of ammonia is produced.

To attain this result with greater certainty, pour a greatly diluted solution of nitrate or nitrite drop by drop on fragments of amalgam, so as not to cover it completely. In this case there is again a violent disengagement of gas, and at the same time a very decided ammoniacal odour.

The reaction is considerably moderated by the use of an amalgam containing about 1 per cent. of sodium and 15 to 20 per cent. of zinc; very little gas is disengaged, and almost all the nitrogen is transformed into ammonia.

I have also observed that by adding a sufficient quantity of amalgam to the solution of nitrate, the whole of the nitrogen is eliminated, and the solution contains only alkali.

This fact is very easily proved, for if a trace of nitrate or nitrite remained, the simultaneous addition of sulphuric acid and sulphate of iron would develope a brown tint.

To determine the composition of the gases disengaged in these reactions they have been submitted to a careful examination.

These gases all sustain combustion more or less well, less, however, than oxygen and protoxide of nitrogen. They detonate with hydrogen.

Left in contact, cold, for twenty-four hours with a stick of phosphorus their volume remains undiminished. They contain then no free oxygen.

Mixed with oxygen and gas from a battery, the volume does not diminish by detonation. No hydrogen then is present.

Hence it follows that these gases are mixtures of nitrogen and protoxide of nitrogen.

Analysis of these gases by M. Bunsen's eudiometer gave the following results:—

2. Gas proceeding from a saturated solution of nitrate of soda—

	I.		II.
Protoxide of nitrogen .	66·17	volumes	65·95
Nitrogen	33·83	,,	34·05
	100·00	,,	100·00

2. Gas proceeding from a saturated solution of nitrate of soda, diluted with five volumes of water—

	I.		II.
Protoxide of nitrogen .	58·18	volumes	57·75
Nitrogen	42·82	,,	42·25
	100·00	,,	100·00

3. Gas proceeding from a concentrated solution of nitrite of potash—

	I.		II.
Protoxide of nitrogen. .	39·35	volumes	38·77
Nitrogen	60·65	,,	61·23
	100·00	,,	100·00

4. Gas proceeding from a concentrated solution of nitrite of potash, previously diluted with five times its volume of water—

Protoxide of nitrogen . . .	55·37	volumes
Nitrogen	44·63	,,
	100·00	,,

5. A special examination of the same gas for hydrogen showed that it contained none.—*Bulletin de la Société Chimique*, vi., 403, 64.

Researches on Sulphuretted Combinations of Uranium, *by M.* Adolphe Remele.

The following are the principal results of an investigation I have pursued this winter in M. Rivot's laboratory at the Ecole des Mines:—

Sulphide of Uranyle.*—$[Ur_2O_2]S + Aq.$—Hardly anything has hitherto been known of the nature of compounds formed by the action of a solution of alkaline sulphide on salts of uranium. By heating strongly metallic uranium in sulphur vapour, there is obtained, according to most chemists, a sulphide corresponding to the formula UrS, and Rose obtained an analogous substance by passing a current of sulphide of carbon in vapour over the intermediate oxide of uranium heated to redness†; but the reactions of the wet way, though very precise, remain as yet unexplained.

In most chemical treatises it is stated that the precipitate given by hydrosulphate of ammonia in a solution of uranium is sulphide of uranium, having probably a formula analogous to that of the salt of uranium employed. H. Rose was the first to throw a doubt on this opinion; he considered the precipitate in question, on account of a circumstance I will indicate further on, as a mixture of protoxide of uranium and sulphur. Neither of these suppositions are correct.

By pouring excess of hydrosulphate of ammonia into an aqueous solution of nitrate of uranium, a brown precipitate is produced, soluble to a considerable extent in excess of the reagent, and rendering the liquid almost black. On washing, the precipitate alters rapidly, becoming first orange, then light yellow. I have ascertained that the final product of this transformation is hydrated sesquioxide of uranium. For the matter remaining after very prolonged washing disengages water but not ammonia on calcination; it dissolves completely in hydrochloric acid, without giving out sulphuretted hydrogen, and the solution presents all the characteristics of salts of sesquioxide.

After numerous experiments I found a means of collecting the brown precipitate produced by the hydrosulphate of ammonia. This very simple method consists in dissolving nitrate of uranium in alcohol, and precipitating in the alcoholic liquid. Under these circumstances the liquid remains clear, and the precipitate is unalterable in the air; it may be washed with alcohol diluted with a little water, and then dried in a vacuum on caustic potash.

Numerous analyses of the substance thus prepared, which has all the characteristics of a defined compound, show that it contains, besides a certain quantity of sulphide of ammonium, just one equivalent of sulphur and two equivalents of uranium. To ascertain its chemical composition it is necessary to ascertain in what state the uranium is present.

These are the properties of this substance. When precipitated in a solution of nitrate of uranium in water heated to 40 or 50 degrees in presence of hydrosulphate of ammonia it decomposes into a mixture of protoxide of uranium and sulphur, and the opaque liquid regains its transparency‡; on boiling it with water it gradually forms a mixture of hydrate of protoxide of uranium and sulphur; lastly, treated by hydrochloric acid sheltered from the air it yields a green solution of uranium, which gives with ammonia a brownish precipitate of hydrated sesquioxide.

These reactions prove that protoxide of uranium pre-exists in the compound, and that all the uranium is in this state. Moreover, the direct weight has led me approximatively to the same result; having decomposed a given weight of the substance in a sealed tube at about 230°, I found that 63 per cent. of uranium had absorbed 2·18 per cent. of oxygen, passing to the state of green oxide (Ur_3O_4). The brown body is consequently a combination of two equivalents of protoxide of uranium with one equivalent of sulphur.

This composition, which at first appears strange, is satisfactorily explained when we recall M. Peligot's admirable labours on uranium. Here I will merely refer to his hypothesis as to the constitution of salts of uranium. It is well known that the sesquioxide of this metal, contrary to all known sesquioxides, forms with one equivalent of various acids, salts possessing all the properties of neutral salts; as yet no one has succeeded in preparing salts containing three equivalents of acid with one equivalent of oxide. To account for this anomaly, M. Peligot admits the existence of a radical formed of two equivalents of uranium and two of oxygen, and playing the part of a simple metal. Now, all is clear and simple; the sesquioxide, Ur_2O_3, becomes a monoxide $[Ur_2O_2]O$, and with this there is naturally joined one equivalent of acid to form a neutral salt.

This hypothesis receives powerful support from the nature of the compound generally called oxichloride of uranium. Uranium forms no sesquichloride, but in place of it a combination containing the elements of two equivalents of sesquioxide and one equivalent of sesquichloride of uranium. It is a very remarkable fact that this oxichloride forms well-defined double salts with alkaline chlorides. But how is this? By adopting M. Peligot's theory, we have, instead of the oxichloride, a simple chloride, monochloride of uranyle (the name of the radical Ur_2O_2). There is nothing to prevent the latter forming double chlorides; and instead of

$$2Ur_2O_3.\quad Ur_2Cl_3 + 3KCl,$$

we have, for instance,—

$$[Ur_2O_2]Cl + KCl.$$

But it seems to me that the body which I have examined furnishes yet more conclusive proofs of the justness of M. Poligot's opinions. Its formula may be written in two ways: $2Ur_2O_3.Ur_2S_3$; or, again, $[Ur_2O_2]S$. If the first formula represent the true constitution of the compound—if it really is an oxisulphide—there ought then to be a pre-existing sesquioxide of uranium.

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* The first part of the present memoir forms the subject of a note presented through M. Péligot to the Academie des Sciences at the meeting of April 18.

† M. Péligot believes it to be impossible to form in this way a combination of uranium and sulphur. Besides, the latter reaction never gives products the characteristics of which resemble those of ordinary sulphides.

‡ This curious fact well explains H. Rose's opinion that the brown body consisted of a mixture of protoxide of uranium and sulphur. The extreme solubility of this body in acids is a conclusive proof that it cannot contain free protoxide.

But how is it, then, uranium being so easily oxidised, that the substance, decomposed in presence of hydrosulphate of ammonia by the aid of heat, produces only protoxide and sulphur? There can be no doubt that the protoxide pre-exists; and as there are two equivalents of it which combine with one equivalent of sulphur, the only rational explanation seems to be to attribute to these two equivalents of protoxide of uranium the part of a radical.

Thus we have to do with a monosulphide of uranyle $[U_2O_2]S$, analogous to chloride of uranyle; and it will be seen further on that, as the latter combines with alkaline chlorides, the first may combine with the sulphides of the same metals.

The composition indicated is shown by the following numbers:—

Uranium	79·0
Oxygen combined with uranium	10·5
Sulphur	10·5
	100·0

Besides, sulphide of uranyle contains a considerable proportion of water. The material which has served for most of my analyses gave, in 100 parts, 80·3 of sulphide of uranyle, 1·7 of monosulphide of ammonium, and 18 parts of water.

Insoluble in absolute alcohol, sulphide of uranium is partially soluble in pure cold water, to which it imparts a slight brown tinge; but this solution gradually decomposes, and the whole of the uranium is deposited in the state of hydrated sesquioxide or uranate of ammonia. All moderately strong acids, even when diluted with much water, very easily decompose brown sulphide; the combination is almost immediately destroyed, so that two thirds or three-fourths of the sulphur separate in a free state, under the form of small greenish-yellow flakes; very little sulphuretted hydrogen is disengaged.

Freshly-prepared sulphide of uranyle is of a beautiful chocolate brown colour; it is then probably combined with a determinate proportion of sulphide of ammonium, perhaps with that which would lead, for sulphoranylate of ammonia, to the formula corresponding to uranate of ammonia. The first would be $2[Ur_2O_2]S.NH_4S$; the second being $2[Ur_2O_2]O.NH_4O$. The existence of a real combination is so much the more probable that the substance, even after undergoing entire decomposition by washings in a very large quantity of water, still throws off sulphide of ammonium, which dissolves the free sulphur separated at the same time.

In the air this sulphide constantly disengages vapours of hydrosulphate of ammonia, and at the same time its colour changes to greenish brown. The proportions of sulphide of ammonium found in different products by analyses were always smaller than that indicated by the above formula. It seems impossible to free the substance entirely from volatile sulphide.

Sulphide of uranyle may enter into combination with the sulphides of fixed alkaline bases, and it then gives place to sulphuranylates very little soluble in water and alcohol. These compounds are very slightly stable; nevertheless I have prepared several of them in a pure state. Those I have at present studied contain sulphide of potassium, sodium, and barium. They are easily decomposed by acids with disengagement of sulphuretted hydrogen.

(To be continued.)

TECHNICAL CHEMISTRY.

Eighth Report of the Commissioners of Inland Revenue.

The Report of the Commissioners of Inland Revenue contains the usual Report from the Principal of the Laboratory. It is much too long for us to print entire, but some parts will have an interest to most of our readers.

The Report starts with some remarks on the alteration of the amount of work done in the laboratory since the equalisation of the duties on coffee and chicory. By this the necessity for examining some thousands of samples of coffee was removed, and hence we find that whereas in 1862 the excise chemists analysed 5088 samples of coffee, in 1863 they only examined 25 samples.

The extended importations of wines, however, has brought a large increase of work from the Customs department, and as this work has proved of a more difficult nature than the detection of chicory in coffee, the reporter is at pains to show that although there has been a dimiantion of 2722 in the total number of articles analysed, there has, nevertheless, been a considerable accession of work.

With regard to the wines imported, it is remarked:—

"Within the past year, the Customs have adopted very stringent measures for the purpose of suppressing the obnoxious practice, which has been increasing during the last few years, of importing fabricated wines. Ninety-four of these so-called wines were analysed within the period to which this Report refers, the examination of which demanded much care and experience on the part of the analysts."

We must express our regret that the writer has not given us some idea of the composition of these fabricated wines, with the names they pass under, so that the public may be on their guard.

Our readers are aware, from our notices of past Reports, that one duty assumed by the chemist to the Excise is the instruction of a limited number of Excisemen in chemistry. On this subject the Report says:—

"The systematic instruction of young officers in chemistry and other subjects pertaining to the laboratory continues, I may venture to say, to be satisfactory. Ten of these students were examined in June last by Dr. Hofmann, nine of whom passed with much credit through a rather severe examination in both theoretical and practical chemistry. Since the introduction, in October, 1858, of the present system, the laboratory has received forty-nine students, many of whom, when they return to the surveying branch of the service, carry with them, in addition to their scientific knowledge, studious habits and a power of rigorous reasoning and close observation, which cannot fail, I think, to be in the end valuable to the service. The ten officers now under instruction will, I trust, in their final examination, attain, the praiseworthy position arrived at by their predecessors."

Of the special subjects of investigation, the first mentioned is tobacco. In the last Report it was said that the Irish manufacturers were in the habit of adulterating their Cavendish and roll tobacco with liquorice. This adulteration was nearly suppressed by the discovery of a satisfactory mode of detecting it, and the reporter believes that the adulterant is now seldom illicitly used, at which no one will be much surprised when they read that the "Manufactured Tobacco Act of 1863" allows the use of liquorice and other innoxious matters under certain regulations. A personal inspection of a large proportion of the tobacco manufactories of this country during the past year has assured the principal chemist that the tobacco trade was never in a more healthy state than at present. It appears, however, that out of 100 samples examined during the past year thirty-one were adulterated; nineteen with liquorice, six with cane sugar, two with cabbage leaves, two with ground pimento in small quantity, one with chalk, and one with common salt.

The principal adulterant of snuff appears to be lime.

"The law permits the use of lime water in the manufacture of high-dried snuffs, such as Irish and Welsh, but it does not state what proportion of lime shall be present in the water, although there can be little doubt that a perfectly clear solution of lime in water was meant. Many manufacturers, however, assert that such a solution is useless in the manufacture of the snuffs in question, and persist in the use of what may be termed 'lime wash,' or a thick mixture of undissolved lime and water. Several unsuccessful attempts have been made within the last two years to suppress the very gross practice, which is still growing, of using such a mixture; and, from reasons which I have laid before the Board, I have come to the conclusion that until the use of lime in the manufacture of snuff is absolutely prohibited, the fraud can never be crushed, and that even the obtainment of a conviction will always be very uncertain. It has been generally understood that lime was essential in the preparation of high-dried snuff; but I have recently caused a fine specimen of such snuff, made by an eminent firm in Ireland, to be analysed, the result being that no more lime was present than what may be found in normal American tobacco; and I have reason to believe that the same firm strenuously opposed the legalising the use of lime water, and still maintain that lime, even in small quantity, deteriorates the quality of the snuff. Under these circumstances it becomes a matter for consideration whether the permission to employ lime in the manufacture of snuff should not be withdrawn.

"The vicious form of adulteration now under notice is almost entirely confined to the North of Ireland, where it appears the habit is very prevalent amongst the females employed in the linen and other factories, of taking snuff highly charged with lime, and which is known as 'white snuff;' and the manufacturers allege, in extenuation of their dishonest practices, that no other description of snuff is acceptable to their customers; apparently forgetting that they themselves have, by their long continued illicit practices, engendered the habit which they now seek to bring forward as a plea for their fraudulent transactions. I have lately had submitted to me several samples of snuff obtained from manufacturers in Belfast, in which it is impossible to say, from a mere inspection, whether lime or tobacco predominates; and I have received information, which I believe to be true, from respectable members in the trade, that some manufacturers do not even care to use a mixture of lime and water, but actually grind up dry lime with the tobacco in the process of manufacture.

"The evil in question appears to demand, both upon social and fiscal considerations, an immediate remedy. It can never be suppressed under the existing law, and, as I have before observed, the only effectual course to be adopted is the entire prohibition of the use of lime in the manufacture of snuff; and I have reason to believe that the obnoxious practice is distasteful to many manufacturers, who, however, feel compelled in self-defence to adopt it, and that its continuance is mainly due to the unscrupulous operations of one or two members of the trade.

Samples of Snuff Analysed.

Year.	Number of Samples.		
	Genuine.	Adulterated.	Total.
1863	32	25	57

"The illicit ingredients found in the adulterated samples comprised the ground husks of rice, dyewoods, orris root, cereal starch, peroxide of iron, and an inordinate amount of lime.

Pepper.—There is reason to believe that this commodity is still adulterated extensively either by the grinders of, or the wholesale dealers in, the article. Within the period to which this Report refers, 30 samples of pepper have been analysed, 18 of which were adulterated, the adulterants being the starch and husks of rice, wheat starch, linseed meal, and in one instance ground pine wood. In 17 of the samples ground rice, varying in quantity from 2 to 15 per cent., was present, while the husk of rice, which was found in 16 samples, ranged in quantity from 1 to 10 per cent.

A seizure, made in the provinces, of adulterated pepper led to the examination, within the past year, of the stocks of pepper in the possession of two firms in London largely engaged in the trade, the result being that my assistants who examined the stocks felt it their duty to seize about one ton and a-half of ground pepper heavily adulterated with rice husks, the whole of which was forfeited to the Crown and destroyed. In these instances I am of opinion that the dealers were innocent of the fraud, and that the grinder alone was the offender; but still they cannot be exculpated from blame, for whilst they insist upon the return of an unreasonable percentage of ground produce from the public grinders, they must expect that the loss of weight which unavoidably occurs in grinding will be made up by illicit materials. In the two cases under notice the proportion of the adulterating ingredients present in the several parcels of pepper seized varied from about 10 to 15 per cent., so that the revenue was being defrauded of at least one-tenth of the duty chargeable on the commodity.

Samples of Pepper Analysed.

Year.	Number of Samples.		
	Genuine.	Adulterated.	Total.
1863	12	18	30

Chicory.—Seeing that the sophistication of coffee has long been an established practice, it is not surprising that certain unscrupulous dealers have, within the past year, attempted the adulteration of chicory, as the inducement to commit that fraud is now equal to that which has for many years led to the adulteration of coffee. Penalties have been imposed upon five dealers for committing the fraud in question, the adulteration consisting of from 15 to 20 per cent. of ground roasted peas and the husks of mustard seed, whilst in one sample sago starch was found.

During the year 25 samples of coffee and chicory have been analysed, 20 of which proved to be genuine.

Beer.—Twenty-six samples of beer and of materials found in the possession of licensed brewers have been analysed, and of these 20 were found to be illicit; the prohibited ingredients being, in 14 samples, grains of paradise, one of these samples containing, in addition, tobacco; in two others cocculus indicus was present in large and dangerous quantities; two samples contained capsicum; and the remaining two proto-sulphate of iron. Generally, the prohibited materials employed in the adulteration of beer are not injurious to health, and it is but seldom that instances come under my notice in which poisonous substances have been used, the object of the fraudulent brewers or retailers of beer being more to increase the bulk of their goods than to render the beer stupifying by the addition of noxious materials. Still, there can be little doubt that the practice of adulterating beer with poisonous matters, such as tobacco and coculus indicus, is more prevalent than might be inferred from the small number of detections made, as the fraud is difficult to discover unless the offender be caught in the act of committing it. Considering, therefore, this circumstance, and the abominable character of the offence, I am of opinion that it would be only just to the community to make public the names of those persons convicted of adding coculus indicus or other deleterious substances to beer brewed for sale; and I feel no hesitation in stating that the two instances of the use of the dangerous drug in question occurred in the neighbourhood of Wirksworth, in Derbyshire, and that many of the detections of the use of grains of paradise were also made in the same district; and I may further say that experience of many years has led me to the conclusion that the adulteration of beer with drugs, as distinguished from the mere dilution or increasing of the bulk of the article, is more prevalent in the Midland Counties and the West Riding of Yorkshire than in any other parts of the kingdom.

Malt.—The adulteration of malt with ungerminated grains appears to be steadily decreasing.

Wood Naphtha.—Nothing has transpired since the date of my last Report to lead me to suspect that the revenue is endangered by allowing methylated spirit to be used duty-free in the arts and manufactures. It is possible that the spirit in its impure state may to some small extent be illicitly used, seeing that the present duty on spirits affords a strong incentive to the commission of the fraud; but it would be too much to expect that, while all other duties are always in some degree evaded, this one should be exempt from the same evil. There can, however, be no doubt that any loss which the revenue may sustain through the improper use of methylated spirit is insignificant when compared with the benefit which accrues to the manufacturing interests of the country from the permission to use such spirit duty-free.

From the character of the samples which have been forwarded to my department within the past year under the supposition that they were illegal, it would appear that the attempts to apply methylated spirit to purposes not contemplated by the Legislature are directed more to the use of the spirit in medicinal preparations than to its introduction as a beverage. The samples referred to comprised five of hyponitrous ether, one of laudanum, one of tincture of rhubarb, one of wood spirit, three of methylated spirit which had been attempted to be purified, two samples termed "Indian brandee," one termed "Indian whiskee," and one "Hollands whiskee." The four last-named samples might, from the names given to them, be supposed to be imitations of brandy and whiskey, which, however, they did not in the least resemble, as they were simply very impure hyponitrous ether, highly sweetened, and made from methylated spirit, the "brandee" being coloured. They were very nauseous, and would never be drunk as a beverage except by persons having a most vitiated taste; and the price at which I am informed they are sold—namely, from 2d. to 3d. per ounce, or at the rate of from 26s. 8d. to 40s. per gallon—appears to confirm the statements made by those who prepare and vend the articles, that they are purchased by the poor classes, not as substitutes for potable liquors, but as specifics for many complaints which they are advertised to cure. I may add that the sale of these compounds appears to be confined to certain localities in Lancashire and Cumberland.

The wood spirit used in the methylation of alcohol is invariably tested in the laboratory as to its fitness for the purpose for which it is intended, and during the past year ninety-five samples have been so examined.

Miscellaneous Samples.—The number of samples difficult to classify examined within the past year is 360, of which 135 were from the Customs and 225 from the Excise. The samples comprised wines, spirits, cordials, essences made from wood spirit, cordialised malt extract, cane and starch sugars, syrups, "dandelion coffee," extract of chicory, "coffee finings," "breakfast beverages," dextrine, glycerine, medicinal preparations, cattle food, and sheep wash.

PROCEEDINGS OF SOCIETIES.

CANTOR LECTURES.

"*On Chemistry Applied to the Arts.*" *By Dr.* F. Crace Calvert, *F.R.S., F.C.S.*

Lecture VI.

Delivered on Thursday Evening, April 28, 1864.

Flesh, its chief constituents, boiling and roasting. *Animal black*, its manufacture and applications. Various methods of preserving animal matters. Employment of animal refuse in the manufacture of *prussiate of potash*. A few words on the decay of organic matters, and their fermentation and putrefaction.

It will be easily understood, by those who have done me the honour of attending this course, that this last lecture must touch upon a variety of topics, in order to give an idea of some of the applications which animal matters receive, and which yet remain to be discussed.

Flesh.—M. Chevreul, in 1835, and Baron Liebig, in 1845, examined the changes which flesh undergoes when placed in contact with hot and cold water; and the following table, taken from Liebig's interesting work on the chemistry of food, will give you an idea of the composition of flesh:—

Cold water.		Action of boiling.	
Soluble	66	Coagulated albumen...	29·5
		Gelatine	6·0
		In solution	30·5
Insoluble	164	Fibres & membranes	164·0
Fat	20		
Water	750		
	1000		

Liebig and Chevreul further succeeded in isolating, of the 30 parts soluble in water, some of the following substances:—

Kreatine	$C_8\ H_9\ N_3\ O_4 + 2\ HO$
Kreatinine	$C_8\ H_7\ N_7\ O_2$
Sarcosine	$C_6\ H_7\ N_3\ O_4$
Inosinic acid	$C_{10}\ H_6\ N_2\ O_{10}$
Lactic acid	$C_6\ H_5\ O_5 + HO$
Guanine (Scherer) ...	$C_{10}\ H_5\ N_5\ O_2$
Xanthine (Strecker) ...	$C_{10}\ H_4\ N_4\ O_4$
Glycocoll " ...	$C_4\ H_5\ N\ O_4$
Leucine	$C_{12}\ H_{13}\ N\ O_4$
Osmazome	

The most important mineral salts in flesh are the acid phosphate and lactate of lime, and, according to Fremy, the acid phosphate of potash and chloride of potassium. The above statement shows that flesh is a most complicated substance, and it is easy to conceive that this must be so, when it is remembered that it is derived from blood, of which it contains a large amount; but a most interesting and curious fact is that, whilst blood is rich in salts of soda and poor in salts of potash, in flesh the relative proportion of these salts is directly reversed. Another interesting fact is the small amount of solid matter contained in flesh, and also the small amount of nutritive matter it yields to water under the most favourable circumstances. I repeat "the most favourable circumstances," for when meat is placed in boiling water the 3 per cent. of albumen it contains is coagulated, closing the vessels of the flesh, and preventing all further exit of the fleshy fluids, and such should be the case when meat is intended to be eaten as boiled meat and is properly cooked; but when the object in view is to extract the whole of the matter soluble in water, as in the preparation of beef tea, then the meat should be cut in small pieces, and brayed in a mortar with water, the whole then thrown into clean linen and pressed. The juice of the flesh so obtained should then be carried just to the boil, again passed through the strainer, and after the addition of a little common salt will be ready for the patient. Beef tea, even prepared by this process, which is certainly the best to my knowledge, contains, as the table above shows, but a small quantity of nutritive matter, there being only a little gelatine and a small proportion of the other substances named above. Chevreul attributes the odour of beef tea and meat soups to osmazome, and Liebig to kreatine; in fact, Liebig considers kreatine to be one of the essential substances characterising the aroma of various kinds of flesh. Liebig during his researches on this substance succeeded in obtaining from—

Fowls' flesh	3·21 of kreatine.
Ox heart	1·37 ,,
Pigeon	0·82 ,,
Beef	0·69 ,,

Further he observed, that the flesh of wild animals contained a much larger proportion of kreatine than those which were confined; for instance, that there was six times as much in the flesh of a wild fox as in that of a tame one. Allow me to say a few words on the properties of this curious substance, which presents itself in the form of moderately large white rectangular prisms, having a pearly lustre, soluble in water, insoluble in alcohol; and although this substance is neutral, it is converted when heated with hydrochloric acid into another solid crystallised substance called kreatinine, which possesses strong alkaline properties. When kreatine, instead of being treated by an acid is acted upon by baryta, it is converted into an acid compound called inosinic acid. Liebig ultimately succeeded in finding these substances, as well as another called sarcosine, in various animal secretions. I shall not take up more of your time by discussing the chemical properties of these substances, but merely state that they enable us to distinguish real soup tablets from spurious ones. For this purpose a solution of the tablet in cold water should be made, when, if genuine, it will give a precipitate with chloride of zinc, whilst the spurious one, which contains gelatine but no kreatine, will not do so. Another reaction is, that the pure article will yield 85 per cent. of its weight to alcohol, whilst the imitation will only yield about five.

Preservation of meat and animal substances.—A low temperature is most favourable to the preservation of flesh and other animal substances; it will not enter into putrefaction, the best proof of which is that elephants in a perfect state of conservation have been found in Siberia buried in ice, where they have doubtless existed for many thousands of years. It is also well known that the inhabitants of polar regions preserve their meat fresh by burying it in snow, and I mentioned an instance in one of my previous lectures, viz., the preservation and bleaching of sturgeons' bladders on the banks of the Volga. A high state of dessication or dryness also contributes powerfully to the prevention of decay. Thus in Buenos Ayres and Monte Video, meat is cut into thin slices, covered with maize flour, dried in the sun, and consumed largely, under the name of Tassago or Charke, by the inhabitants of the interior, and also by the black population in Brazil and the West Indies. Further, dried meat reduced to powder is used by travellers in Tartary and adjacent countries, and I may add that of late years meat biscuits have been extensively consumed by the emigrants having to travel from the United States to California and the West Coast generally. It is stated that six ounces per diem of this meat biscuit will maintain a man in good health throughout the journey. A remarkable instance of the preservation of animal matter by extreme dessication is related by Dr. Wefer, who states that in 1787, during a journey in Peru, he found on the borders of the sea many hundreds of corpses slightly buried in the sand, which, though they had evidently remained there for two or three centuries, were perfectly dry and free from putrefaction. Although it is not within the scope of these lectures to describe the preservation of vegetable matters, still I cannot refrain from mentioning the interesting method adopted by MM. Masson and Gannal, by which, as you are doubtless aware, vegetables are preserved in the most perfect manner. Their process is most simple, as it consists in submitting the vegetables for a few minutes to the action of high pressure steam (70 lbs. to the square inch), then drying them by air heated to 100°, when, after compression by hydraulic pressure, they are made into tablets for sale, and when required for use it is only necessary to place the tablets for five hours in cold water, when the vegetable substances swell out to their former size and appearance and are ready for cooking. As the presence of oxygen or air is an essential condition of putrefaction, the consequence is that many methods have been invented to exclude that agent, or rather, as I shall show at the end of this lecture, the sporules or germs of cryptogamic plants or animals, which are the true ferments or microscopic source of fermentation and putrefaction. Permit me to describe concisely some of the methods proposed; and I believe that one of the best processes for excluding air was that invented by Appert, in 1804. It consists in introducing the meat or other animal substance with some water into vessels which are nearly closed; these are then placed in a large boiler with salt (which raises the boiling point of the liquor), and the contents of the vessels are kept boiling for about an hour, so as to exclude all air, and destroy, by the high temperature, all the sporules or germs of putrefaction they may contain, when they are hermetically closed. M. Chevalier Appert has improved this process in placing the prepared vessels in a closed boiler, by which means he raises the temperature (by pressure) to 234°, which effects the same purpose more rapidly and economically. To give you an idea of the extent of this trade, I may state that M. Chevalier Appert prepared above 500,000 lbs. of meat for the French Army in the Crimea. I am aware that many modifications have been applied to this process, but I shall only mention that of Mr. G. M'Call, who adds to the previous principle of preservation a small quantity of sulphite of soda, well known to be a powerful antiseptic. The beautiful specimens now on the table, which have been kindly lent to me by Messrs. Fortnum and Mason and by Mr. M'Call, will satisfy you of the applicability of the above-named methods for the preservation of meat and other animal substances. But before concluding this part of my lecture, I must add that the preservation of animal and vegetable substances by the exclusion of air and cryptogamic sporules is also effected by other methods than those above described; for instance, they are imbedded in oil, or in glycerine, as suggested by Mr. G. Wilson, or into saccharine syrups. I should not forget to mention that several plans have been proposed for protecting animal matter by covering their external surfaces with coatings impermeable to air. Two of the most recent are the following:—M. Pelletier has proposed to cover the animal matter with a layer of gum, then immersing it in acetate of alumina, and lastly in a solution of gelatine, allowing the whole to dry on the surface of the animal matter. The characteristic of this method is the use of acetate of alumina, which is not only a powerful antiseptic, but also forms an insoluble compound with gelatine, thus protecting the animal matter from external injury. Mr. Pagliari has lately introduced a method which is stated to give very good results. It consists in boiling benzoin resin in a solution of alum, immersing the animal matter in the solution, and driving off the excess of moisture by a current of hot air, which leaves the above antiseptics on the animal matter. It is scarcely necessary to mention the old method of using smoke arising from the combustion of various kinds of wood, except to state that in this case it is the creosote and pyroligneous acid which are the preservative agents. The preservation of animal matter by a very similar action is effected by the use of carbolic acid, a product obtained from coal tar. It is much to be regretted that this substance, which is the most powerful antiseptic known, cannot be made available for the preservation of organic substances intended for use in arts and manufactures, no cheaper or more effective material can be found. For example, I have ascertained that one part of carbolic acid added to five thousand parts of a strong solution of glue will keep it perfectly sweet for at least two years, and probably for an indefinite period. Also, if hides or skins are immersed for twenty-four hours in a solution of one part of carbolic acid to fifty of water, and then dried in the air, they will remain quite sweet. In fact, hides and bones so prepared have been safely imported from Monte Video. From these facts and many others with which I am acquainted I firmly believe that this substance is destined, within a few years, to be largely used as an antiseptic and disinfectant. I need hardly speak of the power of chloride of sodium, or common salt, in preserving animal matters, and it is highly probable that the interesting process described to you on the 13th April, by Mr. J. Morgan, for the employment of salt, is likely to render great service in preserving animal food from putrefaction. But with regard to the feasibility of its use in Monte Video and Buenos Ayres, I cannot offer an opinion, as it depends upon so many local circumstances which it is impossible to appreciate here. Messrs. Jones and Trevethick displayed at the last Exhibition some meat, fowls, and game preserved by the following process, which received the approbation of the jurors. Meat is placed in a tin canister, which is then hermetically closed, with the exception of two small apertures in the lid. It is then plunged into a vessel containing water, and after the air has been exhausted through one aperture by means of an air pump, nitrogen is admitted through the second aperture, and the alternate action of exhausting the air and replenishing the nitrogen is kept up until the whole of the air has been removed. The nitrogen in its turn is exhausted, and sulphurous acid gas admitted. The two apertures are then soldered up, and the operation is completed. As I consider the action of carbon on animal matters rather as a case of oxydation than of preservation, I shall refer to that subject further on, and shall, therefore proceed to consider the employment of certain animal matters not yet alluded to during this course of lectures, such as the flesh of dead animals not used as food, and those other parts of their carcases which have not been applied in any of the processes already described. The greatest part of these refuse matters are used for producing animal black, which differs from bone black, referred to in my first lecture, being used in the state of impalpable powder, whilst bone black or char is composed of small hard grains. The manufacture of animal black is generally carried out by introducing into horizontal retorts connected with a coil or condenser, and with an exit pipe for the gases, some of the animal matters mentioned; on the application of heat decomposition occurs, the oily matters distil and condense in the worm, and constitute what is called Dippel's oil, formerly much used in the art of currying certain classes of leather; water also distils, charged with a variety of ammoniacal salts, which are generally converted into sulphate of ammonia for agricultural purposes. As to the gases, they are usually ignited and burnt to waste. The carbonaceous mass which remains in the retort is removed, and ground to powder in a mill with water, allowed to settle, and, lastly, dried and sold under the name of animal black. Its chief uses are in the manufacture of blacking and printing ink. Another manufacture which consumes a large quantity of animal refuse, especially the horns, hoofs, &c., of too inferior a quality to be used for the purposes described in my first lecture, is that of the yellow prussiate of potash, a most important salt, for it is extensively used in calico printing, silk and wool dyeing, and in the manufacture of the pigment called prussian blue, for gilding silver, copper, and other inferior metals; and lastly, it is the source from which cyanide of potassium is procured, a substance much employed in the art of photography. Let me now call your attention to the manufacture of prussiate of potash, the greatest portion of which is prepared at the present day still by the old process devised by Dr. Woodward, F.R.S., in 1724. It consists in introducing into large cast-iron pots American pearlash, melting it, closing the vessel, and then setting the mass in motion by means of a revolving shaft. At this period of the operation hoofs, horns, and other animal refuse, are introduced in small quantities at a time. Under the influence of heat and of the alkali, the nitrogen of the organic matters splits into two parts, one part combining with the hydrogen to form ammonia, which escapes, whilst the other portion unites with the carbon, producing cyanogen, which remains combined with the potassium of the potash. After several hours the operation is considered to be completed, and the melted mass is run out into small cast-iron receptacles; when cool these are placed in large vats with water, and a jet of steam is introduced, and the whole is kept on the boil for several hours, when the cyanide of potassium is partly decomposed, giving rise to carbonate of potash and to cyanide of iron, for not only has a portion of the iron of the melting pots been attacked and combined with the mass, but a certain quantity of iron filings have been used during the operation. However, two parts of the cyanide of potassium combine with one part of cyanide of iron, and the result is that a double cyanide, called ferro-cyanide of potassium, or yellow prussiate of potash, is formed. The liquors are then allowed to clear by standing, and the aqueous solution is evaporated until a pellicle appears on its surface, when it is allowed to cool, and the salt is deposited on strings which have been passed through the crystallising vat, and which facilitate the crystallisation of the prussiate salt. In consequence of the large amount of animal matter used as compared with the quantity of prussiate obtained, this salt has always commanded a good price in the market, and has induced many eminent chemists to try to devise cheaper processes for obtaining it. To attempt here to give merely an outline of these various proposed plans would involve so much technical description as would occupy far too much time for this lecture, but I would recommend those interested in this branch of manufacture to read the learned account given by Dr. A. W. Hofmann, in his report on "The Chemical Products in the last Exhibition," page 57, where they will find the process of M. Gauthier-Bouchard for obtaining salts of cyanogen from the ammoniacal waters of gas works; those of Mr. R. T. Hughes and Messrs. Bramwell, of Newcastle, for the conversion of nitrogen of the atmosphere into cyanide of potassium; that of M. Kamrodt, for decomposing ammonia by carbon carried to a high temperature; and, lastly, that of MM. Margueritte and De Sourdeval, for producing cyanogen from the nitrogen of the atmosphere and fixing it by means of barium. This latter process seems to be highly commended by the learned reporter to whom I have referred.

I must not, however, omit to mention the scientific and interesting process devised by M. Gelis, and based on the chemical reaction which ensues when bisulphide of carbon is mixed with sulphide of ammonium. Yellow prussiate crystallises in large crystals belonging to the octohedral system, composed, as before stated, of two parts of cyanide of potassium, 2CyK, and one of iron, Cy Fe + 3 of water or HO. This salt is freely soluble in water, but is insoluble in alcohol, and when mixed with weak vitriol and heated gives rise to prussic acid, which distils, and may be used either as a violent poison or, in qualified hands, as a most valuable therapeutic agent. When ferrocyanide of potassium is heated with several times its bulk of concentrated sulphuric acid, instead of yielding prussic acid, as above, it gives rise to a poisonous gas, called oxide of carbon, which burns with a beautiful blue flame, and which we have all seen burning in some fireplaces when the combustible matter has lost all its volatile constituents and nothing remains but a red incandescent mass. When chlorine is passed through a solution of this salt chloride of potassium is formed, and the yellow prussiate is converted into red prussiate or ferricyanide of potassium, composed of $3CyK + 3Fe_2Cy_3$. When heated with peroxide of mercury, potash, peroxide of iron, and cyanide of mercury are produced, the latter being a most violent poison. To produce Prussian blue on silk with this salt, all that is required is to dip the silk in a slightly acidulated liquor containing a persalt of iron, and when the silk is washed and mordaunted, it is dipped in a weak acidulated solution of yellow prussiate of potash, when it assumes a beautiful blue colour due to the formation of Prussian blue. To dye wool it is necessary to pass it through a boiling bath composed of yellow prussiate, muriate of tin, and a small quantity of sulphuric acid. Prussian blue is gradually formed, and fixes itself on the fibre. To produce blue on calicoes, a solution of yellow prussiate of potash is made, to which is added some tartaric acid and muriate of tin. This mixture, after having been properly thickened, is printed on the calico, and then submitted to the action of steam, the Prussian blue so produced being fixed on the cotton fibre by means of the oxide of tin, resulting from the decomposition of the salt employed.

Nothing is more simple than to gild or silver metals by means of ferrocyanide of potassium, or to cover iron and other metals with copper. To obtain a gilding liquor, it is only necessary to take 1000 parts of water, adding to it 100 parts of yellow prussiate of potash, 10 parts of chloride of gold, and 1 part of caustic potash. Each of these should be added successively, and the whole of the liquor carried to the boil and filtered. It is then ready for gilding silver or brass objects, when properly attached to the pole of a galvanic battery. The silvering liquor is made by substituting for the chloride of gold, in the above process, ferrocyanide of silver, prepared by adding nitrate of silver to a solution of ferrocyanide of potassium, the white precipitate resulting being washed and added to the liquor intended for silvering. For covering zinc or iron with copper it is simply necessary to substitute the ferrocyanide of copper for that of silver. Ferrocyanide of potassium, as above stated, is also employed for the manufacture of Prussian blue, which was accidentally discovered by Diesbock, in 1718, by adding alum, containing iron, to the ammoniacal liquors sold to him by Dippel, which were produced, as already stated above, during the distillation of animal refuse. These liquors, being rich in cyanide compounds, yielded with the salt of iron of the alum, Prussian blue. At the present day Prussian blue is manufactured by different processes, but they are all based on the principle of mixing various salts of iron with red or yellow prussiate, when double cyanides of iron (or Prussian blues) are produced.

(To be continued.)

ACADEMY OF SCIENCES.

August 29.

The first communication read was a very important memoir by M. Claude Bernard, entitled "*Experimental Researches on Opium and its Alkaloids.*" This eminent physiologist was led to experiment on the effects of all the alkaloids of opium from noticing great and unexpected variations in those effects when the alkaloids were employed to facilitate experiments on living animals. He found, in fact, that the six principal alkaloids—morphine, narceine, codeine, narcotine, papaverine, and thebaine—each produced a particular effect, but the action may be classed under three heads—the soporific, the exciting or convulsive, and the poisonous action. The relative power of the alkaloids to produce these effects is indicated by their position in the following table:—

Soporifics.	Excitants.	Poisons.
Narceina	Thebaine	Thebaine
Morphine	Papaverine	Codeine
Codeine	Narcotine	Papaverine
	Codeine	Narceina
	Morphine	Morphine
	Narceine	Narcotine

Thus it is seen that three only produce purely soporific effects, but even these vary greatly in character and degree. Morphia, for example, produces a stupefying effect. The animal is scarcely insensible, but it becomes a sort of living machine, and will remain in any position in which it is placed. The sensitive nerves are extremely dull, and the extremities may be strongly pinched without disturbing the animal. When roused by a noise it seems frightened, but quickly relapses into narcotism. As the animal awakens it has a haggard look, and the hinder extremities seem partially paralysed, so that it walks like a hyæna.

The effects of codeia are essentially different. The animal is tranquil, and seems to be in calm sleep, but he is at the same time very excitable; a slight noise wakes him up, and he runs away. The sensitive nerves are much less affected than by morphia, and no paralysis is observed when the animal awakens.

Narceia seems to produce the combined effects of morphia and codeia, and appears to be the most strongly soporific principle in opium. The animal sleeps more profoundly, but is not so much stupified as with morphia; and at the same time is not so excitable as when under the influence of codeia. It quickly returns to its natural state, and on awaking is neither frightened nor savage.

All these effects have been confirmed by repeated experiments on all available animals, and they appear to be constant and invariable.

Coming to the poisonous effects of the alkaloids, the author informs us that thebaia is the most active poison. A decigramme of the hydrochlorate of this alkaloid injected into the veins of a dog killed it in five minutes; but it is stated that *two grammes* of hydrochlorate of morphia injected into the veins of a dog of the same size did not cause death. There must, we think, be some mistake here, *two decigrammes*, perhaps, are meant. Codeia stands intermediate as a poison.

Thebaine also stands first as the most powerful agent in producing convulsions.

The inquiry which M. Bernard has thus opened is very large and important, and will, no doubt, be followed out with all the skill and care for which he is distinguished.

M. Payen contributed a note "*On Pyroxylin and Pyroxam.*" The author accounts for spontaneous combustions of pyroxylin by showing that pyroxam, or starch saturated with nitric acid, is much more unstable, and inflames at a lower temperature than pyroxylin. The fibres of linen sometimes contain amylaceous granules, and therefore pyroxylin prepared with it is unstable. The tubular cavities of cotton also contain fatty matters which may possibly affect the composition of the gun-cotton.

The author does not believe in a stable compound such as trinitrocellulose is described.

In a note "*On Carbonic Oxide*," Dr. Calvert clears up some differences between the experiments of Boussingault and Cloez and himself; he now shows that the amount of carbonic oxide formed when oxygen is in contact with an alkaline pyrogallate varies with the temperature.

A paper by M. Michaelson, "*On the Products of the Oxidation of Butylic Alcohol*," shows that when this body is treated with bichromate of potash and sulphuric acid, propylic and butylic aldehydes are produced, and also propionic, butyric, and carbonic acids.

A paper by Mayer, "*On some Ethers of Biatomic Alcohols*," describes the mode of formation and properties of the bibenzoates of propylene and amylene, and the bisalicylates of ethylene and propylene.

M. Liebén contributed a note "*On the Substitution of the Hydrogen of Ether by Chlorine, Ethyl, and Oxethyl.*" The last name is applied by the author to the body $Ꞓ_2H_5Ɵ$.

M. Caventon presented a note "*On Some Bromides, and a New Hydrocarbon of the Hexylic Series.*" He has prepared various compounds of bromine with hexylene, and on heating bromated hexylene $Ꞓ_6H_{11}Br$ with alcoholic solution of potash, formed a body, $Ꞓ_6H_{10}$, isomeric with diallyle, to which he gives the name *hexoylene*.

NOTICES OF BOOKS.

International Exhibition. Jurors' Report on Class II. Section A. Industry of Manures.

(Continued from page 106.)

The next section of this interesting Report is, as we have said, a remarkable one. It traces the course of events which have brought our manurial industry into its present remarkable phasis—a phasis which, it is said, "is purely transitional, and which marks the crisis of a momentous revolution, even now in the course of accomplishment." The events alluded to have their origin in the discovery of the steam-engine. One of the first effects of this discovery was to collect our population in large towns, located usually on rivers leading to the sea. In the earlier stage of this development the use of cesspools was in vogue, and much of the nightsoil produced found its way back to the land. But presently came epidemics, and doctors looking for the cause of these, found it in the cesspools; and forthwith engineers were called in, who effectively drained our towns, but polluted all our great streams and wasted all our manure.

The next great event, also distinctly traceable to the invention of the steam-engine, was the abolition of the corn laws. Protection abolished, "the cultivators of this cold Northern soil were exposed to the competition of rival food-growers, beneath warmer suns, the more prolific cornfields of the South. Upon this unequal competition the English territorial proprietors entered, as upon a struggle for life or death. Abundant manuring seemed at the outset their main, if not their sole resource; hence the rapid and prodigious development (already noted) of the guano trade; hence the multiplication of manurial products from every form of waste, as manifested in the patent records; hence the celebrated 'nitrogen theory' and the 'high-farming' system, to which allusion will presently be made; hence, lastly, that ransacking of the whole world for bones, so criminal in Liebig's view. But steam power, which has imposed upon the British cultivator this struggle for existence, brings him also the means of issuing victorious from the encounter." Steam pumps shall send our urban *ejecta* all over the country; the steam plough shall furrow the land twice as deep and thrice as fast as man and horse; and husbandry shall in time rise from the rank of a *handicraft* to that of a *manufacture*. And if steam could only control the elements and regulate the seasons, all would go well with the British corn manufacturer.

In the meantime, however, the application of town sewage to the land on an extensive national scale still stands adjourned; and, as our readers will see to-day, the matter has not been much advanced by the last Parliamentary commission which considered the subject.

The quantity and dilution of sewage constitutes the great difficulty of dealing with it. The principal contributor to this Report many years ago propounded the formula—"The rainfall to the river, the sewage to the soil," and thus suggested the separation of the surface from the house drainage. But this, in the case of London, is a matter of comparatively little importance, since the daily *ejecta* of each individual becomes diluted in the house with about thirty gallons of water. Whether sewage so dilute is of much use on corn lands, and whether in any case it could entirely replace the use of superphosphates and guano, is still, we believe, an open question. If we were entirely a grass-growing country, the solution of the question might not be difficult; but during a considerable portion of the year corn lands would require no irrigation, and what is to be done with the sewage in the meantime? A great waste, in fact, seems inevitable, unless we take Liebig's advice, and return to the cesspool system in some form or other, or to some system by which the natural manure may be spared the enormous dilution to which it is now subjected. This is the question to which our engineers must soon give their attention; and with our present knowledge of the means of disinfection and deodorisation we have little fear that the end may be accomplished without our being submitted to a "martyrdom of stench," or "the still fiercer martyrdom of blood pollution and loathsome pestilence which stench engenders."

The next part of the Report might have been omitted. There is no necessity in these days to argue against the supposed impracticability of distributing liquid manure all over the country. It is only necessary to show that the manure is worth the distribution, and the subsoil of England, at all events, would probably soon be piped for the purpose, just as the Report states Flanders is already honeycombed with tanks for the storage of liquid manure. But the manure stored in Flanders is not diluted like our own, and, if we do not mistake, it comes from cesspools.

(To be continued.)

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1031. Bounet Frederic Brunel, Brussels, Belgium, "Improvements in treating vegetable fibres, in converting them into pulp, in bleaching the same, and in apparatus employed therein."—Petition recorded April 23, 1864.

1177. James Roy, Liverpool, Lancashire, "Improvements applicable to self-acting mashing apparatus."—Petition recorded May 9, 1864.

1409. Edward Joseph Hughes, Manchester, Lancashire, "Improvements in dyeing and printing."—A communication from Charles Labnth, Paris, France.—Petition recorded June 7, 1864.

1867. Allen Dalzell, Edinburgh, "Improvements in the manufacture of colouring matter applicable to dyeing and printing."—Petition recorded July 26, 1864.

1949. Adolph Hermann Alvin Pflugbaupt, Manchester, Lancashire, "Improvements in producing colour from aniline."—Petition recorded August 4, 1864.

2039. Charles François Darcagne, Upper Thames-street, London, "A new mode of treating or preparing the sorgho plants *(Holchus sorghum)* so as to render the fibre thereof useful in manufactures as a substitute for horsehair and otherwise."—Petition recorded August 16, 1864

Notices to Proceed.

981. Hugo Levinstein, New Bridge Street, Blackfriars, "Improvements in the preparation of purple, violet, and blue aniline dyes."—Petition recorded April 20, 1864.

999. Henry Adrien Bonneville, Rue du Mont Thabor, Paris, France, "A new semi-fluid or solid product obtained by concentrating the saponaceous parts of the quillai tree."—A communication from Emeric de Werchin, Maubenge, France.—Petition recorded April 21, 1864.

1019. James Edward Duyck, Stamford Street, Surrey, "Improvements in distilling and purifying petroleum oils and other hydrocarbons, and in apparatus employed therein."

1021.—James Edward Duyck, Stamford Street, Surrey, "Improvements in treating petroleum and other hydrocarbon oils and fats or fatty bodies."—Petitions recorded April 22, 1864.

1073. Marc Antoine François Mennons, Rue de Dunkerque, Paris, France, "An improved apparatus for the capsulation of fluid medicines."—A communication from Jules Viel, Tours, France.

1076. Richard Hudson Smithett, Inner Temple, and John Davidson, Temple Street, Blackfriars, "Improvements in treating clay, artificial stone, metal, or other plastic or malleable material, to render it more suitable for constructive purposes."—Petition recorded April 29, 1864.

1732. John Forbes, Perth, N. B., "Improvements in distilling liquids, and in the machinery, apparatus, or means employed therefor."—Petition recorded July 12, 1864.

1994. Charles Lowe, Bradford, Lancashire, "Improvements in the manufacture of colouring matters."—Petition recorded August 10, 1864.

2076. Gerin Gabriel Boggio, Paris, France, "A new or improved process for extracting the oil contained in the flour of oleaginous seeds for distilling, rectifying, and evaporating volatile substances, for preparing volatile oils or essences and extracts for dyeing and medical purposes, for desicating animal and vegetable alimentary substances, plants, roots, and flowers, and for ventilating."—Petition recorded August 23, 1864.

CORRESPONDENCE.

Dr. Schwarz's Process for Refining Sugar.

To the Editor of the Chemical News.

Sir,—The attack of Dr. Adriani on my process of sugar refining by means of alcohol and muriatic acid is evidently based upon wrong premises, which, with your permission, I will correct with as much brevity as possible.

Dr. Adriani asserts that alcohol and acetic acid were unsuccessfully tried for this purpose in Belgium in the year 1849. I am, of course, bound to believe his statement, but possibly the failure might be attributed to a deficient knowledge of the correct *modus operandi*. The fact of its being unsuccessful may account for my having no knowledge or record of it; the result, however arrived at, is totally at variance with the experiences of Mr. Dumas, who has adopted it for the estimation of sugar. Next, Dr. Adriani ventures to state that acetic acid is the only acid fit for this purpose. My experience, on the contrary, has convinced me that, good as the acetic acid may be, muriatic acid is preferable on a large scale, not only economically as to its cost, but also from its producing more readily the sugar crystals, and these in a more perfect condition.

The Doctor fears that the inflammability of alcohol might be an obstacle, which, if carried on in an open apparatus, as he seems to suppose, possibly might be attended with some risk; but even so, not so much as the varnish makers incur by the use of methylated spirits which they use at a high temperature, whilst economy, even more than danger from inflammability, conduces to my using hermetically-sealed vessels, by means of which I recover the alcohol at a very small percentage of loss.

By my method not only is the percentage of loss of alcohol very small, but the quantity of alcohol applied is also reduced to a minimum, which will be better seen when compared with the method of Pessier, so much eulogised by the Academie of France, and which is worked on a large scale in that country; it involves the use of 500 to 600 per cent. of alcohol, being about thirty times as much as is required by my process. As to the recovery of the volatilised alcohol, I should feel obliged if Dr. Adriani would assist me to a better process than condensation by a cold water injector. I have, however, practically found it to answer the process very admirably.

Dr. Adriani pays me the personal compliment of assuming that I have not much practical knowledge of sugar refining. In reply to this, I beg to inform him that since the year 1848 I have been actively engaged in Silesia in numerous sugar refineries, as consulting chemist; also that the Society of German Sugar Refiners did me the honour of testing my process, under the superintendence of two of the most experienced sugar refiners, at their own costs and charges, which certainly evinced their sense of my judgment and experience, and which was confirmed by their satisfaction at the novelty and successful working of the process, and the correctness of my deductions, the whole of the crystalline portion of the raw sugar being recovered in a perfectly pure condition.

Dr. Adriani favours barytes as an agent for the utilisation of molasses. This process has been adopted in Russia, where the molasses are of little value, and been abandoned, as it was found that no fish, flesh, or fowl could live in contact with the refuse of the works.

Dr. Adriani fears the action of the acidulated solution of molasses upon the plant used in my process, but forgets that it would only be by great mismanagement that any free acid would be found in the solution, organic acid only being present. I have, moreover, left a piece of iron wire gauze in a mixture of muriatic acid and alcohol many days, and found scarcely a trace of iron in the solution.

With regard to the use of a saturated solution of sugar to free the crystals from the adherent molasses pure sugar must of necessity be used, and becomes so deteriorated by the molasses as to be recovered with difficulty, in a very inferior condition, and with considerable loss. In Germany instead of the saturated solution of sugar pure water is used, thus avoiding the loss of the sugar that has been already purified, but sacrificing a large percentage of crystalline sugar, both processes being alike in principle. The result of a trial by the Commission of the Society of Sugar Refiners of the last-mentioned process as compared with mine, is:—

By my process—89 per cent. of pure, dry, white sugar.
By above process—60 per cent. moist, sticky, white sugar.
With these results in favour of my process the Commission were highly satisfied, and with their testimony I trust your readers will be satisfied, if I have not succeeded in making a convert of Dr. Adriani.

I am, &c. Dr. Schwarz.

London, September 7.

MISCELLANEOUS.

Utilisation of Sewage.—The Select Committee appointed by the House of Commons to inquire into any plans for dealing with the sewage of the metropolis and other large towns, with a view to its utilisation for agricultural purposes, have published their report. Its chief points are as follow:—"The Committee has come to the conclusion that it is not only possible to utilise the sewage of towns by conveying it, in a liquid state, through mains and pipes to the country, but that such an undertaking may be made to result in pecuniary benefit to the ratepayers of the towns whose sewage is thus utilised. That benefit may, in a few years, be greatly increased; for the amount of artificial manure is even at present insufficient, and the sources whence some of the most important are obtained will, in a few years, be exhausted. Other means of fertilising land must therefore be resorted to. The Committee, having examined the Chairman and Engineer of the Metropolitan Board of Works, are of opinion that more might have been done by that Board towards the profitable use of the sewage of London; and that the completion of the outfall sewerage of the metropolis ought, at the earliest possible moment, to be followed by the adoption of a system which may convert that sewage from a nuisance into a permanent and increasing source of agricultural fertility. Even if a pecuniary benefit were not to be secured, yet such a consideration should not deter local authorities from taking such steps as are possible to free rivers from pollution. There can be no doubt as to the injury which results from the practice of conducting sewage and other refuse matters into the rivers, from whence numerous towns, villages, and country populations derive their water supply. It is imperatively necessary that such a practice should be discontinued. No efficient artificial method has been discovered to purify, for drinking and culinary purposes, water which has been once infected by town sewage. By no known mechanical or chemical means can such water be more than partially cleansed; it is always liable to putrify again. Processes of filtering and deodorisation cannot therefore be relied upon to do more than mitigate the evil. Water which appears perfectly pure to the eye is sufficient, under certain conditions, to breed serious epidemics in the population which drinks it. Soils, however, and the roots of growing plants have a great and rapid power of abstracting impurities from sewage water, and rendering it again innocuous and free from contamination. Mr. Ffennell, the Chief Inspector of Fisheries, stated in his evidence that sewage water, in a putrifying state, is destructive to fish; a considerable increase in the amount of food for the people, and of revenue to the owners of rivers, would therefore result from purifying the rivers of the United Kingdom which are now contaminated by sewage and other matters. The removal of house refuse to the land would now be much easier and cheaper than it was formerly; because carriage by suspension in a liquid is the cheapest mode of transport. In many towns of Lancashire there are to this day numerous cesspits. This is the case with Manchester, where the local authorities expend about 20,000*l.* a year for emptying them and removing the contents to the land, and receive back 50 per cent. by the sale of the material. We recommend that the important object of completely freeing the entire basins of rivers from pollution should be rendered possible by general legislative enactment, enabling the inhabitants of such entire districts to adopt some controlling power for that purpose; but it should include a provision for compelling local boards to render the sewage of their districts innocuous by application to the land for agricultural purposes. The case of the valley of the Thames (where the purification of the river, which has been sought by the expenditure of enormous sums, is, to a considerable extent, counteracted by the increased discharge of sewage from towns higher up the stream) requires special and immediate attention."

Wave Length of the Thallium Ray.—Many years ago Mr. Fox Talbot discovered that when a continuous spectrum is examined by covering one-half of the pupil of the eye with a thin transparent plate, so as to modify that part of the pencil of rays on the side of the violet part of the spectrum, a number of transverse bands, alternately light and dark, appear to traverse it. Brewster discovered that these bands were not formed when the thin plate was placed on the side of the spectrum corresponding with the red rays. It has since been discovered that these bands may be produced by interposing the thin plate in other portions of the path of the ray, besides putting it close to the eye. Baden Powell and Stokes have since studied the phenomena both experimentally and theoretically, and the latter physicist found that the effects were best produced by the partial immersion of a transparent plate in the liquid of a fluid prism. M. Bernard has lately studied these phenomena, and has arranged his apparatus in the following manner:—A ray of solar light passing through a narrow orifice falls on the slit of a spectroscope, the defringent plate being then placed between the aperture admitting the light and the slit of the spectroscope, and some adjustments and arrangements are made, into the detail of which we need not enter. In this manner M. Bernard is enabled to obtain a very luminous spectrum, and he has been led by an examination of the phenomena to the discovery, that through them he is enabled to obtain the length of the waves of any desired ray of light or spectrum line with much greater accuracy than by the ordinary diffraction method. In his memoir he has given the wave lengths of the seven principal rays of the solar spectrum, together with that of the ray A, which, owing to its faintness, has not yet been satisfactorily determined, and the green ray of thallium. Their values, expressed in millionths of a millimetre, are—

$$A = 760{\cdot}6$$
$$Tl = 535{\cdot}2^{*}$$

The diffringent plate of quartz is about a millimetre thick, and its thickness can be determined with absolute accuracy with the spherometer; and when it is remembered that between A and H there are for this thickness more than 700 interference bands, and that it is easy to estimate to the tenth of a band, it is seen that there are more than 7000 invariable points in this portion of the solar spectrum, and it is by reference to these that M. Bernard proposes to classify the rays of the alkaline metals and other interesting spectra. For this purpose he has constructed an apparatus which acts both as a spectroscope and a goniometer, and which enables the observer to measure to within 10″ the indices, a knowledge of which is necessary to calculate the wave lengths.—*Quarterly Journal of Science, No. III.*

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements* and *Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E C.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. IX. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. X. commenced on July 2, 1864, and will be complete in 26 numbers.

B. S.—The regulations are so varied that the best way is to obtain an introduction to some one connected with the University, and make the inquiry personally.

An Inquirer.—No doubt the same as other vegetable oils, principally low hydrocarbons.

Inquirer.—Received. Shall appear next week.

Studens.—Wurtz's lectures will be continued as soon as Dr. Calvert's are concluded.

Erratum.—In the letter of Dr. Adriani, p. 120, last line but one, *for* "the solution of sugar is being concentrated," *read* "the solution of sugar being so concentrated."

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* Dr. J. Müller (*Quarterly Journal of Science*, vol. i. p. 157) finds the length of the wave of the green thallium line to be 534·8 millionths of a millimetre.

ADDRESS TO STUDENTS.

In the present number we again present our readers with a list of the Chemical Lectures and Classes for the ensuing Session. To many this may appear an unnecessary proceeding, but the experience of past years showed us that the information is appreciated, and proves useful. We need, then, offer no apology for continuing a practice thus sanctioned and approved.

On this occasion again we shall presume to offer but little in the way of advice. The study of chemistry is most often connected with that of some other pursuit—as medicine, pharmacy, or metallurgy—and when specially followed it is generally by gentlemen of mature years and fixed habits. Students of the former class must be left to their teachers, and for the latter any advice is clearly unnecessary.

There is one word, however, which cannot be too often repeated to students, and that is—"Persevere." "You have commenced," we may say, "the study of a science which is pre-eminently fruitful. No other offers such a boundless field for research; no other presents the same certainty of reward. The vast domain of inanimate nature lies before the chemist like a half-deciphered scroll. The great secrets of vital phenomena await the chemist for revelation. No single inducement to persevere is absent. Be the student ambitious of greed or fame, the earnest study of chemistry brings both within his reach. The pecuniary reward may be large, but there is a reward better worth having than riches. The discoverer of chloroform is more to be envied than the most successful patentee; and doubtless there are bodies yet to be discovered which will prove greater blessings to humanity than chloroform."

We need not repeat here the observations we made last year respecting the text-books of the science.

The commencement of the study of Chemistry is both easy and interesting; and it is not until advanced in the course that the student becomes perplexed by complex molecules and conflicting theories. Each lecturer adopts some particular view on classification and the constitution of bodies, and necessarily has but little time to discuss opposing theories. But in the course of reading the student is certain to meet with ideas which may be strange to him, and of which he may desire some explanation. It may be of use, then, to refer to Mr. Galloway's "Second Step in Chemistry" as a guide to the advanced student through the labyrinth of modern chemical theories. The chemist who shall reduce all these to one perfect and consistent system, it will be seen, is still wanting; but if he must yet be waited for, let us at least hope that he will be found among those who begin their studies this year.

There is one subject to which we may direct especial attention, since our notice is so often called to it by correspondents; and that is, the opportunities for obtaining chemical instruction in the evening. Some knowledge of chemistry is so often found to be desirable by those practically engaged in various occupations, that many are anxious to make use of the only time available to them for special studies. To those so circumstanced in London, we must point out the advantages which are offered by the evening classes at King's College, and the Birkbeck course at University College. The list of private teachers also contains the names of gentlemen who devote some evenings to practical instruction; and the provincial list includes classes which offer peculiar advantages.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Remarks on the Parabenzole Series, by A. H. Church, *M.A., Professor of Chemistry, Royal Agricultural College.*

In 1855 I first announced the existence of parabenzole in coal naphtha; in 1857 I published further details regarding the new hydrocarbon; and in 1859 I discovered a second member of the parabenzole series—namely, paratoluole. My experiments on these liquids will be found in the *Philosophical Magazine* for the years above named. My attention has been recalled to the subject by the researches of MM. Béchamp, Beilstein, and Naquet. A liquid contained in coal naphtha, which, it appears, M. Beilstein and Dr. H. Müller regard as xylole, has been stated by M. Béchamp to be new; and I am inclined to think that it is not the original xylole of M. Cahours, but paraxylole, a hydrocarbon, whose existence I surmised in the spring of last year. The xylole upon which M. Cahours worked he found to boil between 128° and 130°. I assigned to this liquid the boiling point 126·2°; for this substance the name xylole should be retained. The xylole of M. Beilstein and Dr. H. Müller boils at 139°—the very point at which my paraxylole remains in steady ebullition.

From the "Researches on the Refraction, Dispersion, and Sensitiveness of Liquids," by Dr. Gladstone and the Rev. T. P. Dale, one may draw convincing arguments as to the independent existence of parabenzole, &c. The following table gives a few of the most important physical differences of the new series, as compared with that to which benzole belongs:—

Substance.	Boiling point.	Density.	Specific refractive energy.
Benzole . . .	80·8	·8667	5564
Parabenzole .	97·5	·8469	5684
Toluole . . .	103·7	·8650	5478
Paratoluole .	119·5	·8333	5658

In each case the para compound differs from the normal one in having a higher boiling point, a lower density, and a higher specific refractive energy.

A distinguished foreign chemist hazarded the conjecture, so I am told, that parabenzole was a mixture of benzole and toluole. I should very much like to know how the mixture of two indifferent hydrocarbons having nearly the same density could form a liquid having a very much lower density. Where no heat is evolved, where no action takes place, it is reasonable to infer that no contraction or expansion occurs. (I have determined this in the present case by direct experiment.) Add equal volumes of pure benzole and toluole, what is the density of the mixture? The mean of ·8667 and ·8650—namely, ·8658. What is the density of parabenzole? ·8469. Similar results are obtained with other mixtures of benzole and toluole: the mixtures are, of course, also totally different in their chemical and physical deportment from pure parabenzole.

The same observations apply to paratoluole, &c. My results sufficiently account for the discrepancies in the boiling point assigned to toluole. I have very little doubt that there are at least two isomers of each member of the benzole series; and there may be many more. A comparison of the boiling points of the three first members of the normal and of the para series may prove interesting.

		Difference.
Benzole	80·8	16·7
Parabenzole . . .	97·5	
Toluole	103·7	15·8
Paratoluole . . .	119·5	
Xylole	126·2	12·8
(?) Paraxylole . . .	139·0	

I have formerly pointed out that a similar difference (15·°C.) occurs between the isomeric turpentines. With reference to Dr. H. Müller's pseudo-cumole, I do not at present see its relation to any series: it is curious that its boiling point, 140·5, should be nearly identical with that of the same chemist's xylole, 139°.

I have accumulated during the last few years many interesting facts relating to the parabenzole series, which I hope to publish in a complete form before long.

EXAMINING BOARDS.

UNIVERSITY OF LONDON.

Examiners in Chemistry.—Dr. Debus; Dr. Miller, King's College.

The University of London is not an educating body; it simply grants degrees. A knowledge of Chemistry is necessary for the Matriculation Examination.

Heat—its sources. Expansion. Thermometers—relations between different Scales in common use. Difference between Temperature and Quantity of Heat. Specific and latent heat. Calorimeters. Liquefaction. Ebullition. Evaporation. Conduction. Convection. Radiation.

Chemistry of the Non-Metallic Elements, including their compounds as enumerated below—their chief physical and chemical characters—their preparation, and their characteristic tests.

Oxygen, Hydrogen, Carbon, Nitrogen, Chlorine, Bromine, Iodine, Fluorine, Sulphur, Phosphorus, Silicon.

Combining proportions by weight and by volume. General nature of Acids, Bases, and Salts. Symbols and Nomenclature.

The Atmosphere—its constitution; effects of Animal and Vegetable life upon its composition.

Combustion. Structure and properties of Flame. Nature and composition of ordinary Fuel.

Water—Chemical peculiarities of natural waters, such as rain-water, river-water, spring water, sea-water.

Carbonic Acid. Oxides and Acids of Nitrogen. Ammonia. Olefiant Gas, Marsh Gas. Sulphurous and Sulphuric Acids. Sulphuretted Hydrogen.

Hydrochloric Acid. Phosphoric Acid and Phosphuretted Hydrogen. Silica.

In the Examination for Honours the Candidate, not more than twenty years of age, who shall most distinguish himself in Chemistry will receive a Prize to the value of Ten Pounds in money or books.

DEGREE OF BACHELOR OF SCIENCE (B.SC.).

This recently-instituted Degree is conferred on Candidates who pass a satisfactory Examination in Mathematics, Mechanical and Natural Philosophy, Zoology, Animal Physiology, Geology and Palæontology, and Chemistry.

For the first examination of the Candidate a knowledge of Inorganic Chemistry only is necessary, including the following subjects:—

Matter; simple and compound.

Elementary bodies classed. Metallic and Non-Metallic bodies.

Chemical combination and Mechanical mixture. Solution.

Outlines of Crystallography. Isomorphism. Dimorphism. Allotropic conditions of matter. Chemical Affinity. Laws of Combination by weight and by volume, as deduced from the history of the individual elements. Equivalent numbers. Equivalent volumes. Symbolical notation. Formulæ. Nomenclature.

Chemical actions produced under the influence of Heat. Nature of Combustion. Structure and properties of Flame. Principles of Illumination. Chemical action of Light. Photography.

Oxygen. Ozone.

Hydrogen. Water.

Nitrogen. Chemical constitution of the Atmosphere. Diffusion of Gases. The Oxides of Nitrogen. Nitric Acid. Ammonia.

Chlorine, Bromine, and Iodine. Their compounds with Oxygen and Hydrogen. Theory of Bleaching.

Fluorine and Hydrofluoric Acid.

Sulphur. Sulphurous Acid. Manufacture and Chemical applications of Sulphuric Acid. Other Oxygen compounds of Sulphur. Sulphuretted Hydrogen.

Phosphorus. Oxygen and Hydrogen compounds of Phosphorus. Theory of Acids. Monobasic, Bibasic, and Tribasic Acids.

Carbon. Carbonic Oxide and Carbonic Acid. The principal Hydrogen compounds of Carbon. Manufacture of Coal-gas.

Silicon and Boron. Their compounds with the elements previously enumerated.

Metals. Characters of Metals as a Class. Metallurgical Processes. Alloys. Classification of the Metals.

Potassium. Nitre; Gunpowder. Theory of the action of Gunpowder.

Sodium. Manufacture of Carbonate of Soda.

Barium. Strontium. Calcium. Mortars. Cements. Magnesium. Aluminium. Glass. Porcelain.

Manganese. Iron. Composition and properties of cast iron, wrought iron, and steel. Chromium. Cobalt. Nickel. Zinc. Cadmium. Lead. Manufacture of white lead.

Copper. Mercury. Bismuth. Tin. Arsenic. Antimony. Silver. Gold. Platinum.

Principal compounds of the metals with the Non-Metallic elements. Theory of salts.

Principles of Mineral Analysis.

Principles of Electro-Chemistry.

In the Examination for Honours the Candidate, not more than twenty-two years of age, who shall most distinguish himself in Chemistry and Natural Philosophy shall receive an Exhibition of Forty Pounds per annum for the next two years.

SECOND EXAMINATION FOR B.SC. DEGREE.

This Examination embraces Organic Chemistry, including the following subjects:—

Ultimate analysis of Organic bodies. Calculation of empirical formulæ. Methods of controlling empirical formulæ. Determination of the equivalents of organic acids and bases; examination of products of decomposition; determination of the vapour density of volatile bodies.

Law of substitution. Compound radicals. Homologous series.

The Chemical history of the Cyanogen group. Cyanogen. Hydrocyanic acid. Cyanic acid and Urea. Fulminates. Cyanuric acid. Sulphocyanic acid. Chlorides of Cyanogen. Uric acid.

Amylaceous and saccharine substances. Fermentation. Alcohol, wine, beer, bread, &c.

Homologues of Alcohol. Ethers, simple and mixed. Oxidation of Alcohol. Aldehyde and Acetic acid and their homologues. Anhydrides, simple and mixed. Compound ethers.

Diatomic Alcohols and their acids. Glycol and Oxalic acid and their homologues.

Triatomic Alcohols. Glycerine. Fatty and oily bodies. Saponification.

Vegetable acids. The principal.

Ammonia and its derivatives. Ammonium and Ammoniacal salts. Amides and Amines, their classification. The chief natural Organic Bases.

Colouring matters. Indigo and its derivatives. Principles of Dyeing.

The chief constituents of the Vegetable organism. Cellulose, Vegetable fibrin, Albumin, Casein, Glutin, &c.

The chief constituents of the Animal organism. Animal fibrin, Albumin, Casein, Gelatin. Blood, Milk, Bile, Urine, &c.

Decay, putrefaction. Destructive distillation.

The Chemical principles of the process of Nutrition and of Respiration in Plants and Animals.

The Candidate, not more than twenty years of age, who in the Examination for Honours shall most distinguish himself in Chemistry and Biology will receive Fifty Pounds per annum for the next two years, with the title of University Scholar.

EXAMINATIONS IN CONNEXION WITH THE DEPARTMENT OF SCIENCE AND ART, SOUTH KENSINGTON.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom.

This sum is administered by the Science and Art Department.

The object of the grant is to promote instruction in Science, especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The following are among the Sciences towards instruction in which aid is given:—Acoustics, Light, Heat, Magnetism, and Electricity. Inorganic Chemistry. Organic Chemistry. Geology. Mineralogy. Mining. Metallurgy.

The assistance granted by the Science and Art Department is in the form of—1. Payments on results to certificated teachers. 2. Grants towards the purchase of apparatus, &c. 3. Public examinations in which Queen's Medals, Honorary Certificates, and Prizes are awarded, held at all places complying with certain conditions. On the results of these examinations the payment on results is made to the teachers.

Examinations for Certificates to teach any of the before-mentioned Sciences are held annually, commencing in the first week in November, at South Kensington. Examinations will also be held in Dublin and Edinburgh if five candidates register themselves for examination in Ireland and in Scotland. Any person whatever may attend this examination by sending in his name to the Secretary of the Science and Art Department before October 15, stating the subject or subjects in which he wishes to be examined. Certificates of three grades are given in each group and each subject. These certificates are only considered as simple records of the results of examination in the various sciences before mentioned, entitling the teacher to earn payments by successful teaching in the subjects for which he is certificated.

The Science and Art Department holds, through the agency of each Local Committee, in May of each year, a public examination of all Science schools and classes in any locality throughout the United Kingdom which complies with the requisite conditions. On the results of this examination the payments are made to certificated teachers. Application for it must be made to the Secretary of the Science and Art Department before the end of March in each year, stating the number of persons and the subject or subjects in which they are to be examined. All registered students of Science classes under certificated teachers (except Science certificated teachers) are eligible to receive Queen's prizes and Queen's medals under the conditions hereafter mentioned.

The results of the May examination are classified under the following heads:—(1) first class, (2) second class, (3) third class, (4) honourable mention, (5) pass, and (6) failed. The names of the successful candidates, those under the first five heads, are published. The standard of attainment required may be raised from year to year. For the pass it is only such as will justify the examiner in reporting that the instruction has been sound, and that the students have benefited by it. Those who have obtained a higher degree of proficiency are classed as honourable mention, or as 3rd, 2nd, or 1st class, according to their merit.

To the 1st class are given Queen's prizes, consisting of books chosen by the candidates from lists furnished for that purpose. These prizes are unlimited in number, except that a student who has once received a 1st class Queen's prize cannot receive a prize in the same subject again. If such student should be again successful, his name will simply be recorded in the published list. To the 2nd and 3rd class certificates of merit recording the result of the examination are given.

The Queen's medals are, one gold in each group, one silver and two bronze in each subject, for competition throughout the United Kingdom. Only registered students of schools and classes under local committees can obtain medals. They cannot be taken by middle class students who are more than 17 years of age.

The payments to the certificated teacher are as follows:—He receives 1*l.* for every student of the industrial classes who has received forty lessons from him in a subject in which he is certificated, and passes in such subject of scientific instruction; 2*l.* for every one who is honourably mentioned; 3*l.*, 4*l.*, or 5*l.* for every one who takes a 3rd, 2nd, or 1st class. These students must have received forty lessons at least from the teacher since the last examination at which payment was claimed on their account. The forty lessons need not necessarily be all given in one year, but may extend over a longer period. 5*l.* is the maximum that can ever be claimed on account of the instruction of any one pupil in a subject.

A grant towards the purchase of apparatus, diagrams, &c., of 50 per cent. on the cost of them, is made to Science schools and classes in Mechanics' and similar institutions where the teacher is certificated, and to the extent of 5*l.* to other poor schools and classes.

The travelling expenses (second class railway fare and 10s. per diem personal allowance) of a candidate in attending the November examination are paid if he be successful in taking a certificate or in improving the grade of one he has already taken.

CHEMICAL LECTURES.

ROYAL SCHOOL OF MINES AND COLLEGE OF CHEMISTRY.

Chemistry.—Professor A. W. Hofmann, F.R.S.

The instruction in Chemical Science embraces—

1. A Course of Lectures on Experimental Chemistry with special reference to the applications of Chemistry in the Arts and Manufactures.

2. A systematic Laboratory Course for the Practice of Chemical Analysis.

The Lectures are delivered in the Theatre of the Royal College of Chemistry, Oxford Street.

Chemical Laboratory.—The general Laboratory for instruction in chemical manipulation, in qualitative and quantitative analysis, and in the method of performing chemical researches, is under the direction of Dr. Hofmann. The Royal College of Chemistry having become the property of the Government, its spacious and well-furnished Laboratories are used for the instruction of the pupils of the Royal School of Mines.

There are three terms in the collegiate year, of three months each. The Laboratory hours are from 10 a.m. to 5 p.m., with the exception of Saturdays, when the Laboratory closes at 2 o'clock.

Each Laboratory student works independently, there being no classes. All operations are superintended by the Professor and his Assistants. A table with drawers, cupboards, and shelves, is appropriated to every pupil. The Institution supplies gas, fuel, and reagents. The larger and more expensive instruments of the Laboratory, such as air-pumps, thermometers, barometers, condensers, &c., may be used by the students, who are held responsible for their safety. The students have to provide themselves only with the apparatus specified in the Laboratory regulations. More advanced students engaged in private researches have to supply themselves with such materials as are not included amongst the ordinary reagents of the Laboratory.

The charge for instruction in the Chemical Laboratory is 12*l.* for three months, 9*l.* for two months, and 5*l.* for one month.

Metallurgy.—Professor: Dr. Percy, F.R.S.

The course of instruction in Metallurgy consists of Lectures and Laboratory practice.

In the Lectures the processes of extracting metals from their ores are fully described, the chemical principles which they involve are explained, a detailed description is given of the furnaces and machinery employed, and, as far as reliable information can be obtained, the cost of production is stated. The illustrations consist of a very extensive series of specimens, diagrams, and models. Experimental demonstrations are occasionally introduced, but the time required for the satisfactory illustration by experiment of the chemical phenomena which occur in metallurgical process is generally so long as to make it impossible that in this respect the Lecturer of Metallurgy should follow the example of the Lecturer on Chemistry. In the Metallurgical Laboratory the students have the opportunity of conducting all necessary experimental investigations.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy. The instruction comprises assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c., and the examination of ores and metallurgical products.

There are three terms in the collegiate year, of three months each. The Laboratory hours are from 10 to 4 during November, December, January, and February; and from 10 to 5 during the other months, with the exception of Saturdays, when the Laboratory is closed.

The charge for instruction in the Metallurgical Laboratory is 15*l.* for three months, 12*l.* for two months, and 7*l.* for one month.

Lectures to Working Men.—Short Courses of Lectures at suitable periods of the year are given in the evening to Working Men. These courses are systematic, and arranged so as to illustrate, within the period of two years, the principal subjects taught at the Institution. Those for the ensuing Session include Chemistry, Metallurgy, Physics.

UNIVERSITY COLLEGE.

Chemistry.—Professor Williamson, Ph.D., F.R.S.

Daily, except Saturday, from 11 to 12.

Payment to the College, for a Half Term, 3*l.*; for the Term, 6*l.*; Perpetual, 9*l.*

The properties of the more important elements, and the methods of detecting and separating them, will be explained.

Processes for preparing chemical compounds useful in Medicine, or the manufacturing Arts will be examined in connexion with the principles upon which they depend. The construction and use of apparatus for experimental purposes will be shown.

The Subjects of the Course will be considered in the following order:—

Changes in the condition of matter by the action of Heat.

Light in its bearings upon Chemical Action, and in its application to Analysis.

Electricity as an agent of decomposition and change.

The atmosphere in its chemical and physical properties, and its functions in supporting vegetable and animal life. Explanation of the processes of eudiometric analysis, and demonstration of the regularity of combining volumes of gases.

The non-metallic elements, such as sulphur, iodine, &c., and the simplest of their compounds, as sulphuric acid, nitric acid, ammonia, &c.

The metals, and the most useful or remarkable of their compounds, in connexion with the laws of combination; also the constitution of salts, the atomic theory, &c. The tests for poisons will be explained and shown.

About thirty to forty Lectures will be devoted to Organic Chemistry, including the characteristic properties and metamorphoses of the chief groups of organic compounds, whether of animal or vegetable origin, such as the alcohols, fatty acids, alkaloids, acids of the bile, albuminous substances, &c.

Practical Chemistry.—Professor Williamson, Ph.D., F.R.S.

The Professor is aided in the direction of the Students by Assistants.

INSTRUCTION IN ANALYTICAL CHEMISTRY.

Birkbeck Laboratory.

The Course of Instruction in this department is intended for the assistance of Senior Students in the pursuit of all branches of Chemical Investigation, more especially Organic Research, and for the instruction of less advanced pupils in Elementary Analysis. It qualifies the Student for the application of Chemical Science to Agriculture, Medicine, and the Mechanical Arts; and arrangements have been made for giving practical instruction in Gas Analysis. The Laboratory and offices are fitted up completely with the most approved apparatus and utensils for experimental research, both for beginners and advanced Students. They are open daily from 9 a.m.

to 4 p.m. from October 3 until the end of July, with a short recess at Christmas and Easter.

Fee for the Session, 26*l.* 5s.; six months, 18*l.* 18s.; three months, 10*l.* 10s.; one month, 4*l.* 4s., exclusive of the expense of materials. A deduction of 40 per cent. is made for Students who can attend only three fixed days per week.

The Gold Medal as a reward of merit for this Class will be given by the Council as usual.

ELEMENTARY CLASSES OF PRACTICAL CHEMISTRY.

Summer Course.—A Course of Fifty Lessons, of one hour each, on Mondays, Tuesdays, Wednesdays, Thursdays, and Fridays, from 11 to 12, commencing the first week in May.

Fee 4*l.* This payment includes the cost of materials, &c.

Elementary Chemistry—Theoretical and Practical.
Birkbeck Course.

Professor Williamson, F.R.S., and Dr. Russell.

A Course of Fifteen Lessons, of two hours each, on Tuesday and Friday, from the beginning of May to the end of June. Hours, from 7 to 9 p.m. Fee, including the cost of materials, &c., 2*l.*, for Masters of unendowed Schools and Ushers, and for persons engaged in Manufactures, or like pursuits.

The elements of Chemistry are explained to the Class, and the experiments illustrating the subject performed by the Students.

The first part of the Course is devoted to the study of non-metallic elements and compounds, their properties, and the best methods of distinguishing and separating them. In the second part the most important properties of the metals are studied. The ordinary methods of inorganic analysis are especially dwelt on, and solutions frequently given to the Class for analysis.

All the experiments and analyses are repeated by each Student, or by not more than two Students jointly.

KING'S COLLEGE.

CHEMISTRY.

Professor of Chemistry.—W. A. Miller, M.D., F.R.S.

Professor of Practical Chemistry.—G. L. Bloxam, Esq.

Demonstrator.—E. A. Hadow, Esq.

The Course commences with a View of the Forces which concur to the production of Chemical Phenomena, after which the laws of Chemical Attraction are discussed, and the Non-metallic Elements and their principal Compounds are described.

The metals and their principal compounds are next examined, care being taken to point out the applications of the Science to the Arts, and the processes of the different Manufactures, of Metallurgy, and of Domestic Economy, are explained and illustrated.

Examinations of the Class, both *vivâ voce* and by written papers, are held at intervals during the course of the usual Lecture hour. Dr. Miller has published a work on Chemistry, which is used as a text book by the Class.

Third Year.—Students who have completed six Terms in this department are admitted to a Course of "Practical Chemistry," consisting of twelve Demonstrations in each term; and they go through a course of Manipulation in the most important operations of Chemistry, including the first steps of Analysis.

Any Student of this department may be admitted to this Class at any period of his study on payment of an extra fee.

Experimental and Analytical Chemistry in the Laboratory.—The object of this Class is to afford to Students who are desirous of acquiring a knowledge of analysis, or of prosecuting original research, an opportunity of doing so under the superintendence of the Professor and Demonstrator; Students may enter, upon payment of the extra fees, at any time except during the vacation, and for a period of one, three, six, or nine months, as may best suit their convenience. The Laboratory hours are from ten till four daily, except Saturday, on which day the hours are from ten till one.

In addition to the Laboratory Fee, each Student defrays the expenses of his own Experiments. The amount of this expense, which is comparatively trifling, is entirely under his own control.

EVENING CLASSES.

Classes for Evening Instruction are held at King's College from October to March, and during April, May, and June.

The Classes include one for the Elements of Chemistry and one for Practical Chemistry.

The Fee for the former is 1*l.* 11s. 6d.; for the latter, 2*l.* 2s. The Classes meet twice a-week.

MINERALOGY.

Professor.—James Tennant, Esq., F.G.S.

The Course commences with a description of the Physical and Chemical characters of Minerals in general. The principal simple Minerals are next separately considered, and the readiest mode of distinguishing them described.

The course of instruction includes a minute description of all the substances entering into the composition of Rocks, and of those minerals which are also used in the Arts; illustrated by an extensive collection of characteristic specimens, and diagrams of the principal crystalline forms, &c.

LECTURES AT LONDON MEDICAL SCHOOLS.

ST. BARTHOLOMEW'S HOSPITAL AND COLLEGE.

WINTER SESSION.

Lecturer.—Dr. Odling, Monday and Friday, at half-past ten, and Wednesday, at ten. One course, 5*l.* 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. Odling, Monday, Tuesday, Thursday, and Friday, from eleven to one. One course, 2*l.* 2s.

CHARING CROSS HOSPITAL AND COLLEGE.

WINTER SESSION.

Lecturer.—Mr. C. W. Heaton. Tuesday, Thursday, and Saturday at ten. One session, 5*l.* 5s.

The Laboratory is open daily from ten to four p.m.

SUMMER SESSION.

Practical Chemistry.—Mr. Heaton. Monday, Wednesday, and Friday. One session, 2*l.* 2s.

ST. GEORGE'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. H. M. Noad. Tuesday, Thursday, and Saturday, at twelve. One course, 6*l.* 6s.

SUMMER SESSION.

Practical Chemistry.—Dr. Noad. Daily, at half-past nine. One course, 4*l.* 4s. Besides the usual course, instruction is given in the Laboratory daily by Dr. Noad.

GUY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. Taylor. Tuesday, Thursday, and Saturday, at eleven. One course, 5*l.* 5*s.*

SUMMER SESSION.

Practical Chemistry.—Mr. Stevenson. Monday, Wednesday, and Friday, from ten to one. One course, 4*l.* 4*s.*

LONDON HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. Letheby. Monday, Wednesday, and Friday, at half-past ten. One session, 7*l.* 7*s.*

SUMMER SESSION.

Practical Chemistry.—Dr. Letheby. Monday, Wednesday, and Friday, at a quarter-past eleven. One session, 2*l.* 2*s.*

ST. MARY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. Matthiessen. Tuesday, Thursday, and Saturday, at a quarter-past ten a.m. One session, 5*l.* 5*s.*

SUMMER SESSION.

Practical Chemistry.—Dr. Matthiessen. Saturday, from nine to one. One session, 3*l.* 3*s.*

MIDDLESEX HOSPITAL.

WINTER SESSION.

Lecturers.—Mr. Taylor and Mr. Heisch. Monday, Wednesday, Friday, and Saturday, at eleven. One session, 3*l.* 3*s.*

SUMMER SESSION.

Practical Chemistry.—Mr. Taylor and Mr. Heisch. Monday, Thursday, and Friday, at half-past eleven. One session, 5*l.* 5*s.*

ST. THOMAS'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. J. Bernays. Tuesday, Thursday, and Saturday, at eleven.

SUMMER SESSION.

Practical Chemistry.—Dr. A. J. Bernays. Friday, at twelve; Saturday, ten to one.

WESTMINSTER HOSPITAL.

WINTER SESSION.

Lecturer.—Mr. F. Dupré, Ph.D. Tuesday and Thursday, at three; Friday, at half-past ten. One course, 5*l.* 5*s.*

SUMMER SESSION.

Practical Chemistry.—Mr. F. Dupré. Tuesday and Thursday, at half-past nine. One course, 2*l.* 2*s.*

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, 17, BLOOMSBURY SQUARE, W.C.

LECTURES ON CHEMISTRY AND PHARMACY BY DR. REDWOOD.

These Lectures will be delivered on Wednesday and Friday mornings, at half-past 8 o'clock.

Part 1.—Physics in relation to Chemistry and Pharmacy.

Part 2.—Chemistry of Inorganic Bodies.

Part 3.—Chemistry of Organic Bodies.

Fee.—For Registered Apprentices and Associates of the Society, 10s. 6d. For those not connected with the Society, 1*l.* 1*s.*

Students have free admission to the Library and Museum.

Laboratory.—The suite of Laboratories for Practical Instruction in General and Pharmaceutical Chemistry is under the direction of Dr. Attfield, assisted by Mr. Tilden. Fee for the entire session of ten months, 26*l.* 5*s.* The Laboratories are open from half-past 9 a.m. till 5 p.m. Students can enter at any period during the Session.

Two Jacob Bell Memorial Scholarships of 30*l.* each are open to competition annually in July.

ROYAL VETERINARY COLLEGE, CAMDEN TOWN.

Professor.—Richard V. Tuson.

The Session commences October 3, and ends May 1.

Lectures on Chemistry and Veterinary Materia Medica on Monday, Wednesday, and Friday mornings, from eleven till twelve.

Practical Chemistry in the new Laboratory daily.

PRIVATE TEACHERS OF CHEMISTRY IN LONDON.

Mr. J. C. Braithwaite, 54, Kentish Town Road, N.W. —Chemical and Toxicological Class on Monday and Thursday evenings at 8. Laboratory open daily, except Saturdays.

Professor E. V. Gardner, F.C.S.—College of Experimental and Natural Philosophy, 44, Berners Street. Laboratory and Class Rooms open daily, morning and evening.

Evening Classes in connexion with the Department of Science and Art. The chemical lectures embrace courses on—I. Elementary Chemistry. II. Chemistry and Chemical Analysis. III. Organic Chemistry. IV. Geology and Mineralogy. A Laboratory Class also meets on two evenings in each week.

Mr. S. Highley, F.G.S., F.C.S., &c. — Scientific Educational Museum, 18, Green Street, Leicester Square, gives evening class instruction in the following educational courses:— Geology, Mineralogy, chemical and physical. Photography: its principles, practice, and applications, &c., &c.

Mr. Henry Matthews.—Laboratory, 30, Gower Street, Bedford Square, gives practical instruction in Chemistry in its application to Medicine, Agriculture, and Commerce. Laboratory open daily.

Dr. Medlock, 20, Great Marlborough Street, Regent Street.

Messrs. Nesbit, Lansdell, and Co.—College of Chemistry and Agriculture, 38, Lower Kennington Lane, S., Practical and Analytical Chemistry, Mr. J. Lansdell, F.C.S., 10 a.m. to 5 p.m.

Polytechnic Institution.—Professor Pepper.—A course of Lectures on the Chemistry of the Non-Metallic Elements will be given on Monday evenings during the present term.

Mr A. P. Turner.—Laboratory, 3, Upper Baker Street, N.W., gives practical instruction in Chemistry in all its branches. The class of instruction is modified to suit the requirements of the student.

UNIVERSITY OF OXFORD.

Professor of Chemistry.—Sir B. C. Brodie, Bart., M.A., F.R.S.

Lee's Reader in Chemistry.—A. G. V. Harcourt, M.A.

A commodious Laboratory is attached to the new museum.

Scholarships of about the value of 75*l.* are obtainable at Christchurch, Magdalen, and other Colleges, by competitive examination in Natural Science.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. D. Liveing, M.A.

A Course of Lectures is delivered every Lent and Easter Term. The former course must be attended by candidates for the B.A. and LL.B. degrees. Candidates for Medical degrees must attend both courses.

There is no University Laboratory, but Sidney and St. John's Colleges have laboratories of their own. The latter is open to members of other Colleges when not fully occupied by its own.

A new and commodious laboratory, in connexion with Downing College, will shortly be ready for use.

PROVINCIAL SCHOOLS.

BIRMINGHAM.—QUEEN'S COLLEGE.

Professor of Chemistry.—Alfred Anderson.

A Course of seventy Lectures on General Chemistry during the Winter Session, and a Practical Course for the Medical Boards in the Summer.

The Laboratory is open for daily instruction.

BIRMINGHAM.—SYDENHAM COLLEGE.

Professor of Chemistry.—Dr. A. Hill.

A Course of Lectures on General Chemistry during the Winter Session, and a Practical Course in the Summer.

The Laboratory is open for daily instruction.

BIRMINGHAM.—MIDLAND INSTITUTE.

Lecturer on Chemistry.—Mr. W. M. Williams.

BRISTOL.—BRISTOL MEDICAL SCHOOL.

Lecturer on Chemistry.—Mr. Herapath.

BRISTOL SCHOOL OF CHEMISTRY.

Conducted by Dr. F. W. Griffin.

A Course of Lectures on General Chemistry, commencing in October, and Laboratory instruction throughout the year.

ROYAL AGRICULTURAL COLLEGE, CIRENCESTER, GLOUCESTERSHIRE.

Professor of Chemistry.—A. H. Church, M.A. Oxon., F.C.S.

Assistant Professor of Chemistry.—R. Warington, Esq., jun., F.C.S.

The Session commences on August 3. Three Courses of Lectures are now being delivered: one Course on Agricultural Chemistry, by Dr. Anderson, of Glasgow, is just about to conclude; the other Courses, on Inorganic and Organic Chemistry, will be continued to the end of the Session. The Lectures are illustrated by experiments and specimens. Some stress is laid upon the knowledge of important minerals, of which, in the College Museum, there is a good collection, lately enriched by valuable additions presented by Capt. Guise.

The lectures are given at the following hours:—

Inorganic Chemistry.—Tuesday, 2 p.m.; Thursday (catachetical), 10 a.m.; Friday, 9 a.m.

Organic Chemistry.—Thursday, 3 p.m.; Friday, 2 p.m.

The Course of Instruction in Practical Chemistry in the Laboratory comprises Chemical Manipulation for the 1st Class, Qualitative Analysis for the 2nd, and Quantitative Analysis for the 3rd. The book used in these Classes is "Church's Laboratory Guide for Students of Agricultural Chemistry" (Van Voorst). Examples for the 3rd Class are selected from Agricultural Products and Materials. Students of the 4th Class who are desirous of obtaining the College Diploma work in the Professor's private laboratory.

Chemical Manipulation.—Monday, 2 p.m.; Wednesday, 9 a.m.

Qualitative Analysis.—Tuesday, 10 a.m.; Thursday, 11 a.m.

Quantitative Analysis.—Thursday, 2 p.m.; Friday, 2 p.m.

The Autumn Session of the College divides October 6. The Spring Session will commence about January 8, 1865.

HULL AND EAST RIDING SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Mr. Walton.

The usual Courses for the Medical Boards.

LEEDS SCHOOL OF MEDICINE.

Lecturers on Chemistry.—Messrs. Scattergood and R. Reynolds.

The usual Courses for the Medical Boards.

LEEDS MECHANICS' INSTITUTION AND LITERARY SOCIETY'S LABORATORY.

Chemical Classes for instruction in Elementary, Practical, and Analytical Chemistry.

Teacher.—Mr. George Ward, F.C.S.

The usual Sessional Course of instruction in abstract and applied Chemistry will commence on Friday, September 30, at 8 p.m.

The Elementary Class meets on Friday evenings, 8.15 to 10.

A Class for the study of Organic Chemistry meets on Monday evenings, 8.15 to 9.30.

Practical Chemistry, Laboratory Course, Tuesday and Thursday evenings, from 8 to 10 o'clock.

Fees, payable in advance:—Elementary Chemistry, Friday, per Session, 1*l.* 15s.; 5s. per month. The subscription includes a selection of apparatus and material specially adapted for the course of instruction. To pupils providing their own materials, 1*l.* 1s. per Session. Organic Chemistry, Monday, per Session, 10s. 6d. Practical Chemistry, Tuesday and Thursday, per Session, 2*l.* 2s.; 6s. per month. Including apparatus and material.

LIVERPOOL COLLEGE OF CHEMISTRY.

Principal.—Dr. Sheridan Muspratt.

Assistant.—Mr. M. Murphy.

Laboratory open daily, except Saturdays. The principal or his assistant is always present from 10 to 5.

A Course of Practical Chemistry for Medical Students in the Summer.

LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Dr. J. B. Edwards.

The usual Courses for the Medical Boards.

MANCHESTER ROYAL SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Mr. D. Stone.

The usual Courses for the Medical Boards.

A Laboratory is connected with the School.

OWEN'S COLLEGE, MANCHESTER.

(IN CONNEXION WITH THE UNIVERSITY OF LONDON.)

Chemistry.—Professor H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Junior Class.—Wednesday and Saturday, from 9.15 to 10.15 a.m.

Subject: Inorganic Chemistry, comprising the laws of chemical combination, and a description of the properties and mode of preparation of the elementary bodies and their most important inorganic compounds. Fee, 3*l.* 3s.

Senior Class.—Tuesday and Thursday, from 9.15 to 10.15 a.m.

Subject: Organic Chemistry, giving the properties and relations of the best defined groups of organic bodies, and the laws regulating their formation.

Students are expected to answer the written exercises and attend the *viva voce* examinations given in these classes.

Fee, 3*l.* 3s. For both classes, 5*l.* 5s.

Extra Class.—Wednesday, from 4 to 5 p.m.

Subject: Technological Chemistry.

The chemical principles involved in the most important chemical manufactures will be chiefly considered in this course. The subjects will be discussed as follows, and as far as time will permit:—

1. Production of Heat—Heat of Combustion—Combustibles—Coal.
2. Production of Light—Coal Gas—Measurement of Illuminating Power of Coal Gas—Distillation of Coal.
3. Water and Air, as regards their Sanitary and Technological Relations.
4. Processes concerned in the manufacture and application of the Alkalies.
5. Dyeing and Calico Printing.
6. Manufacture of Acids.
7. Manufacture of Glass and Porcelain.

Students attending this course must be acquainted with the principles of chemical science. Fee, 2*l.* 2s.

Analytical and Practical Chemistry.—Laboratory Course.—Professor Henry E. Roscoe, B.A., Ph.D., F.R.S. (The Professor is assisted in the instruction of the students by Mr. C. Schorlemmer.)

The aim of this course is to make the student practically acquainted with chemical science, to enable him to conduct analysis and original research, and to fit him for applying the science to the higher branches of Art, Manufactures, and Agriculture. To accomplish this, an attendance of not less than four days per week during three whole Sessions is, as a rule, necessary. It is very advisable that each laboratory student should attend or should have attended the course of lectures on Theoretical Chemistry.

The College Laboratory will be open for students daily from 10.30 a.m. until 5 p.m., except on Saturdays, when it will be closed at 1.30. Half an hour, from 1.30 until 2, allowed for dinner.

The Laboratory is fitted with every convenience for the prosecution of practical chemistry, all branches of qualitative and quantitative analysis, and original research. Each student is provided with a separate working table, set of tests, fuel, water, and gas, free of expense; but he is required to provide his own apparatus, a few of the more expensive reagents, and the chemicals required for his experiments. Other apparatus or instruments of a more expensive description may be obtained on loan from the Laboratory Steward, subject to regulations to be prescribed by the Professor.

Fees for the Session.—Students working six days per week, 21*l.*; ditto four days, 17*l.* 17s.; ditto three days, 13*l.* 13s.; ditto two days, 9*l.* 9s.; ditto one day, 5*l.* 5s.; Students entering the Laboratory Class at or after Christmas, for not less than two days per week, will be charged two-thirds of the fees for the whole Session.

Special Fees for Shorter Periods.—For six months, six days per week, 17*l.* 17s.; five months, ditto, 15*l.* 15s.; four months, ditto, 13*l.* 13s.; three months, ditto, 10*l.* 10s.; two months, ditto, 7*l.* 7s.; one month, ditto, 4*l.* 4s. Students working only one day per week will ordinarily be required to spend three hours of that time at a class which will be held on Saturday mornings, from 10.30 a.m. to 1.30 p.m.

Chemical Calculations.—Instruction in the methods of Quantitative Estimation in Chemistry, and intended to supplement the instruction in Practical Chemistry, will be given by Mr. Schorlemmer, on Mondays, from 4 to 5 p.m.

Laboratory students are recommended to attend and to answer the written exercises and the *viva voce* questions given in this class.

Free to all students attending the Laboratory Classes. Fee to others, 1*l.* 1s.

Dalton Chemical Scholarships.—Two, each of the annual value of 50*l.*, offered in alternate years, and tenable for two years. The scholarships are awarded for the best original investigations in chemistry prosecuted at the College, with a satisfactory written examination in Chemistry.

The Lectures on Chemistry in Owen's College are recognised by the University of London for its Medical Degrees, by the Royal College of Surgeons, and by the Apothecaries' Hall.

NEWCASTLE SCHOOL OF MEDICINE.

(IN CONNEXION WITH THE UNIVERSITY OF DURHAM.)

Lecturers on Chemistry.—Dr. T. Richardson, and Mr. Browell.

The usual Courses for the Medical Boards.

The Laboratory is open every day from 10 to 5 for instruction in analysis, &c., &c.

SHEFFIELD MEDICAL INSTITUTION.

Lecturer on Chemistry.—Dr. Bingley.

The usual Courses for the Medical Boards.

SHEFFIELD SCHOOL OF PRACTICAL SCIENCE AND METALLURGY.

Professor of Chemistry, Metallurgy, and Geology.—James Allen, Ph.D., F.C.S.

The Sheffield School of Practical Science and Metallurgy affords a complete scientific and practical education to students who are destined to become civil, mechanical, or mining engineers, or manufacturers of any kind. Its object is thoroughly to discipline the students in the principles of those sciences upon which the operations of the engineer, metallurgist, or manufacturer depend.

The education is given by means of systematic Courses of Lectures, by Catechetical Class Instruction, by Practical Teaching in the Laboratory and Drawing-room, and occasionally by Field excursions.

The School of Practical Science and Metallurgy is conducted in the buildings of the Sheffield Collegiate School.

Fees.—Chemistry, course of 100 Lectures, 5*l.* 5s. Laboratory Practice, Chemistry.—One whole day each week, 4*l.* 4s. each term. Two whole days each week, 7*l.* 7s. each term. Three whole days each week, 10*l.* 10s. each term. Laboratory Practice, Metallurgy.—One whole day each week, 4*l.* 14s. 6d. each term. Two whole days each week, 8*l.* 8s. each term. Three whole days each week, 12*l.* 12s. each term. Each term extends over four months.

The charge for admission to the Lectures to working men will be 2d. each Lecture.

[The Scottish and Irish Schools are deferred until next week.]

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION.

Address by Sir* Charles Lyell, *Bart., LL.D., D.C.L., F.R.S., &c., President. (Delivered before the Members of the Association at Bath, September* 14, 1864.)

Gentlemen of the British Association,—The place where we have been invited this year to hold our thirty-fourth meeting is one of no ordinary interest to the cultivators of physical science. It might have been selected by my fellow-labourers in geology as a central point of observation, from which, by short excursions to the east and west, they might examine those rocks which constitute, on the one side, the more modern, and on the other the more ancient records of the past, while around them and at their feet lie monuments of the middle period of the earth's history. But there are other sites in England which might successfully compete with Bath as good surveying stations for the geologist. What renders Bath a peculiar point of attraction to the student of natural phenomena is its thermal and mineral waters, to the sanatory powers of which the city has owed its origin and celebrity. The great volume and high temperature of these waters render them not only unique in our island, but perhaps without a parallel in the rest of Europe, when we duly take into account their distance from the nearest region of violent earthquakes or of active or extinct volcanoes. The spot where they issue, as we learn from the researches of the historian and antiquary, was lonely and desert when the Romans first landed in this island, but in a few years it was converted into one of the chief cities of the newly conquered province. On the site of the hot springs was a large morass, from which clouds of white vapour rose into the air; and there first was the spacious bath-room built, in a highly ornamental style of architecture, and decorated with columns, pilasters, and tessellated pavements. By its side was erected a splendid temple dedicated to Minerva, of which some statues and altars, with their inscriptions and ornate pillars, are still to be seen in the museum of this place. To these edifices the quarters of the garrison, and, in the course of time, the dwellings of new settlers were added; and they were all encircled by a massive wall, the solid foundations of which still remain.

A dense mass of soil and rubbish, from ten to twenty feet thick, now separates the level on which the present city stands from the level of the ancient Aquæ Solis of the Romans. Digging through this mass of heterogeneous materials, coins and coffins of the Saxon period have been found; and lower down, beginning at the depth of from twelve to fifteen feet from the surface, coins have been disinterred of Imperial Rome, bearing dates from the reign of Claudius to that of Maximus in the fifth century. Beneath the whole are occasionally seen tessellated pavements still retaining their bright colours, one of which, on the site of the Mineral-water Hospital, is still carefully preserved, affording us an opportunity of gauging the difference of level of ancient and modern Bath.

One of our former Presidents, Dr. Daubeny, has remarked that nearly all the most celebrated hot springs of Europe, such as those of Aix-la-Chapelle, Baden Baden, Naples, Auvergne, and the Pyrenees, have not declined in temperature since the days of the Romans; for many of them still retain as great a heat as is tolerable to the human body, and yet when employed by the ancients they do not seem to have required to be first cooled down by artificial means. This uniformity of temperature, maintained in some places for more than 2000 years, together with the constancy in the volume of the water, which never varies with the seasons, as in ordinary springs, the identity also of the mineral ingredients which, century after century, are held by each spring in solution, are striking facts, and they tempt us irresistibly to speculate on the deep subterranean sources both of the heat and mineral matter. How long has this uniformity prevailed? Are the springs really ancient in reference to the earth's history? or, like the course of the present rivers and the actual shape of our hills and valleys, are they only of high antiquity when contrasted with the brief space of human annals? May they not be like Vesuvius and Etna, which, although they have been adding to their flanks, in the course of the last 2000 years, many a stream of lava and shower of ashes, were still mountains very much the same as they now are in height and dimensions from the earliest times to which we can trace back their existence? Yet, although their foundations are tens of thousands of years old, they were laid at an era when the Mediterranean was already inhabited by the same species of marine shells as those with which it is now peopled; so that these volcanoes must be regarded as things of yesterday in the geological calendar.

Notwithstanding the general persistency in character of mineral waters and hot springs ever since they were first known to us, we find on inquiry that some few of them, even in historical times, have been subject to great changes. These have happened during earthquakes which have been violent enough to disturb the subterranean drainage and alter the shape of the fissures up which the waters ascend. Thus, during the great earthquake at Lisbon in 1755, the temperature of the spring called La Source de la Reine, at Bagnères de Luchon, in the Pyrenees, was suddenly raised as much as 75° F., or changed from a cold spring to one of 122° F., a heat which it has since retained. It is also recorded that the hot springs at Bagnères de Bigorre, in the same mountain-chain, became suddenly cold during a great earthquake which, in 1660, threw down several houses in that town.

It has been ascertained that the hot springs of the Pyrenees, the Alps, and many other regions are situated in lines along which the rocks have been rent, and usually where they have been displaced or "faulted." Similar dislocations in the solid crust of the earth are generally supposed to have determined the spots where active and extinct volcanoes have burst forth; for several of these often affect a linear arrangement, their position seeming to have been determined by great lines of fissure. Another connecting link between the volcano and the hot spring is recognisable in the great abundance of hot springs in regions where volcanic eruptions still occur from time to time. It is also in the same districts that the waters occasionally attain the boiling temperature, while some of the associated stufas emit steam considerably above the boiling-point. But in proportion as we recede from the great centres of igneous activity, we find the thermal waters decreasing in frequency and in their average heat, while at the same time they are most conspicuous in those territories where, as in Central France or the Eifel in Germany, there are cones and craters still so perfect in their form, and streams of lava bearing such a relation to the depth and shape of the existing valleys, as to indicate that the internal fires have become dormant in comparatively recent times. If there be exceptions to this rule, it is where hot springs are met with in parts of the Alps and Pyrenees which have been violently convulsed by modern earthquakes.

To pursue still further our comparison between the hot spring and the volcano, we may regard the water of the spring as representing those vast clouds of aqueous vapour which are copiously evolved for days, sometimes for weeks, in succession from craters during an eruption. But we shall perhaps be asked whether, when we contrast the work done by the two agents in question, there is not a marked failure of analogy in one respect—namely, a want, in the case of the hot spring, of power to raise from great depths in the earth voluminous masses of solid matter corresponding to the heaps of scoriæ and streams of lava which the volcano pours out on the surface. To one who urges such an objection it may be said that the quantity of solid as well as gaseous matter transferred by springs from the interior of the earth to its surface is far more considerable than is commonly imagined. The thermal waters of Bath are far from being conspicuous among European hot springs for the quantity of mineral matter contained in them in proportion to the water, which acts as a solvent; yet Professor Ramsay has calculated that if the sulphates of lime and of soda, and the chlorides of sodium and magnesium, and the other mineral ingredients which they contain, were solidified, they would form in one year a square column nine feet in diameter, and no less than 140 feet in height. All this matter is now quietly conveyed by a stream of limpid water in an invisible form to the Avon, and by the Avon to the sea; but if, instead of being thus removed, it were deposited around the orifice of eruption, like the siliceous layers which encrust the circular basin of an Icelandic geyser, we should soon see a considerable cone built up, with a crater in the middle; and if the action of the spring were intermittent, so that ten or twenty years should elapse between the periods when solid matter was emitted, or (say) an interval of three centuries, as in the case of Vesuvius between 1306 and 1631, the discharge would be on so grand a scale as to afford no mean object of comparison with the intermittent outpourings of a volcano.

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* We have omitted those portions of the President's Address which do not particularly relate to chemistry or physical science.

Dr. Daubeny, after devoting a month to the analysis of the Bath waters in 1833, ascertained that the daily evolution of nitrogen gas amounted to no less than 250 cubic feet in volume. This gas, he remarks, is not only characteristic of hot springs, but is largely disengaged from volcanic craters during eruptions. In both cases he suggests that the nitrogen may be derived from atmospheric air, which is always dissolved in rain water, and which, when this water penetrates the earth's crust, must be carried down to great depths, so as to reach the heated interior. When there, it may be subjected to deoxidating processes, so that the nitrogen, being left in a free state, may be driven upwards by the expansive force of heat and steam, or by hydrostatic pressure. This theory has been very generally adopted as best accounting for the constant disengagement of large bodies of nitrogen, even where the rocks through which the spring rises are crystalline and unfossiliferous. It will, however, of course be admitted, as Professor Bischoff has pointed out, that in some places organic matter has supplied a large part of the nitrogen evolved.

Carbonic acid gas is another of the volatilised substances discharged by the Bath waters. Dr. Gustav Bischoff, in the new edition of his valuable work on chemical and physical geology, when speaking of the exhalations of this gas, remarks that they are of universal occurrence, and that they originate at great depths, becoming more abundant the deeper we penetrate. He also observes that when the silicates which enter so largely into the composition of the oldest rocks are percolated by this gas they must be continually decomposed, and the carbonates formed by the new combinations thence arising must often augment the volume of the altered rocks. This increase of bulk, he says, must sometimes give rise to a mechanical force of expansion capable of uplifting the incumbent crust of the earth; and the same force may act laterally so as to compress, dislocate, and tilt the strata on each side of a mass in which the new chemical changes are developed. The calculations made by this eminent German chemist of the exact amount of distension which the origin of new mineral products may cause, by adding to the volume of the rocks, deserve the attention of geologists, as affording them aid in explaining those reiterated oscillations of level, those risings and sinkings of land, which have occurred on so grand a scale at successive periods of the past. There are probably many distinct causes of such upward, downward, and lateral movements, and any new suggestion on this head is most welcome; but I believe the expansion and contraction of solid rocks, when they are alternately heated and cooled, and the fusion and subsequent consolidation of mineral masses, will continue to rank, as heretofore, as the most influential causes of such movements.

The temperature of the Bath waters varies in the different springs from 117° to 120° F. This, as before stated, is exceptionally high, when we duly allow for the great distance of Bath from the nearest region of active or recently extinct volcanoes and of violent earthquakes. The hot springs of Aix-la-Chapelle have a much higher temperature, viz., 135° F., but they are situated within forty miles of those cones and lava streams of the Eifel, which, though they may have spent their force ages before the earliest records of history, belong, nevertheless, to the most modern geological period. Bath is about 400 miles distant from the same part of Germany, and 440 from Auvergne—another volcanic region, the latest eruptions of which were geologically coëval with those of the Eifel. When these two regions in France and Germany were the theatres of frequent convulsions, we may well suppose that England was often more rudely shaken than now; and such shocks as that of October last, the sound and rocking motion of which caused so great a sensation as it traversed the southern part of the island, and seems to have been particularly violent in Herefordshire, may be only a languid reminder to us of a force of which the energy has been gradually dying out.

If we adopt the theory already alluded to, that the nitrogen is derived from the deoxidation of atmospheric air carried down by rain-water, we may imagine the supply of this water to be furnished by some mountainous region, possibly a distant one, and that it descends through rents or porous rocks till it encounters some mass of heated matter by which it is converted into steam, and then driven upwards through a fissure. In its downward passage the water may derive its sulphate of lime, chloride of calcium, and other substances from the decomposition of the gypseous, saline, calcareous, and other constituents of the rocks which it permeates. The greater part of the ingredients are common to sea-water, and might suggest the theory of a marine origin; but the analysis of the Bath springs by Merck and Galloway shows that the relative proportion of the solid matter is far from agreeing with that of the sea, the chloride of magnesium being absolutely in excess, that is, 14 grains of it per gallon for 12 of common salt; whereas in sea-water there are 27 grains of salt, or chloride of sodium, to 4 of the chloride of magnesium. That some mineral springs, however, may derive an inexhaustible supply, through rents and porous rocks, from the leaky bed of the ocean, is by no means an unreasonable theory, especially if we believe that the contiguity of nearly all the active volcanoes to the sea is connected with the access of salt water to the subterranean foci of volcanic heat.

Professor Roscoe, of Manchester, has been lately engaged in making a careful analysis of the Bath waters, and has discovered in them three metals which they were not previously known to contain—namely, copper, strontium, and lithium; but he has searched in vain for cæsium and rubidium, those new metals, the existence of which has been revealed to us in the course of the last few years by what is called spectrum analysis.

Professor Bunsen, of Heidelberg, led the way, in 1860, in the application of this new test to the hot waters of Baden-Baden and of Dürkheim in the Palatinate. He observed in the spectrum some coloured lines of which he could not interpret the meaning, and was determined not to rest till he had found out what they meant. This was no easy task, for it was necessary to evaporate fifty tons of water to obtain 200 grains of what proved to be two new metals. Taken together, their proportion to the water was only as one to three millions. He named the first cæsium, from the bluish-grey lines which it presented in the spectrum; and the second rubidium, from its two red lines. Since these successful experiments were made, thallium, so called from its green line, was discovered in 1861 by Mr. Crookes; and a fourth metal, named indium, from its indigo-coloured band, was detected by Professor Richter, of Freiberg, in Saxony, in a zinc ore of the Hartz. It is impossible not to suspect that the wonderful efficacy of some mineral springs, both cold and thermal, in curing diseases, which no artificially prepared waters have as yet been able to rival, may be connected with the presence of one or more of these elementary bodies previously unknown; and some of the newly-found ingredients, when procured in larger quantities, may furnish medical science with means of combating diseases which have hitherto baffled all human skill.

While I was pursuing my inquiries respecting the Bath waters, I learned casually that a hot spring had been discovered at a great depth in a copper-mine near Redruth, in Cornwall, having about as high a temperature as that of the Bath waters, and of which, strange to say, no account has yet been published. It seems that, in the year 1839, a level was driven from an old shaft so as to intersect a rich copper-mine at the depth of 1350 feet from the surface. This lode or metalliferous fissure occurred in what was formerly called the United Mines, and which has since been named the Clifford Amalgamated Mines. Through the contents of the lode a powerful spring of hot water was observed to rise, which has continued to flow with undiminished strength ever since. At my request, Mr. Horton Davey, of Redruth, had the kindness to send up to London many gallons of this water, which have been analysed by Professor William Allen Miller, F.R.S., who finds that the quantity of solid matter is so great as to exceed by more than four times the proportion of that yielded by the Bath waters. Its composition is also in many respects very different; for it contains but little sulphate of lime, and is almost free from the salts of magnesium. It is rich in the chlorides of calcium and sodium, and it contains one of the new metals—cæsium, never before detected in any mineral spring in England; but its peculiar characteristic is the extraordinary abundance of lithium, of which a mere trace had been found by Professor Roscoe in the Bath waters, whereas in this Cornish hot spring this metal constitutes no less than a twenty-sixth part of the whole of the solid contents, which, as before stated, are so voluminous. When Professor Miller exposed some of these contents to the test of spectrum analysis he gave me an opportunity of seeing the beautiful bright crimson line which the lithium produces in the spectrum.

Lithium was first made known in 1817 by Arfvedsen, who extracted it from petalite; and it was believed to be extremely rare, until Bunsen and Kirchhoff, in 1860, by means of spectrum analysis, showed that it was a most widely diffused substance, existing in minute quantities in almost all mineral waters and in the sea, as well as in milk, human blood, and the ashes of some plants. It has already been used in medicine, and we may therefore hope that, now that it is obtainable in large quantities, and at a much cheaper rate than before the Wheal Clifford hot spring was analysed, it may become of high value. According to a rough estimate which has been sent to me by Mr. Davey, the Wheal Clifford spring yields no less than 250 gallons per minute, which is almost equal to the discharge of the King's Bath or chief spring of this city. As to the gases emitted, they are the same as those of the Bath water—namely, carbonic acid, oxygen, and nitrogen.

Mr. Warington Smyth, who had already visited the Wheal Clifford lode, in 1855, re-examined it in July last, chiefly with the view of replying to several queries which I had put to him; and, in spite of the stifling heat, ascertained the geological structure of the lode and the exact temperature of the water. This last he found to be 122° Fahr. at the depth of 1350 feet; but he scarcely doubts that the thermometer would stand two or three degrees higher at a distance of 200 feet to the eastward, where the water is known to gush up more freely. The Wheal Clifford lode is a fissure varying in width from six to twelve feet, one wall consisting of elvan or porphyritic granite, and the other of killas or clay-slate. Along the line of the rent, which runs east and west, there has been a slight throw or shift of the rocks. The vein-stuff is chiefly formed of cellular pyrites of copper and iron, the porous nature of which allows the hot water to percolate freely through it. It seems, however, that in the continuation upwards of the same fissure little or no metalliferous ore was deposited, but, in its place, quartz and other impermeable substances, which obstructed the course of the hot spring, so as to prevent its flowing out on the surface of the country. It has been always a favourite theory of the miners that the high temperature of this Cornish spring is due to the oxidation of the sulphurets of copper and iron, which are decomposed when air is admitted. That such oxidation must have some slight effect is undeniable; but that it materially influences the temperature of so large a body of water is out of the question. Its effect must be almost insensible, for Professor Miller has scarcely been able to detect any sulphuric acid in the water, and a minute trace only of iron and copper in solution.

When we compare the temperature of the Bath springs, which issue at a level of less than 100 feet above the sea, with the Wheal Clifford spring found at a depth of 1350 feet from the surface, we must of course make allowance for the increase of heat always experienced when we descend into the interior of the earth. The difference would amount to about 20° Fahr., if we adopt the estimate deduced by Mr. Hopkins from an accurate series of observations made in the Monkwearmouth shaft, near Durham, and in the Dakinfield shaft, near Manchester, each of them 2000 feet in depth. In these shafts the temperature was found to rise at the rate of only 1° Fahr. for every increase of depth of from 65 to 70 feet. But if the Wheal Clifford spring, instead of being arrested in its upward course, had continued to rise freely through porous and loose materials so as to reach the surface, it would probably not have lost anything approaching to 20° Fahr., since the renewed heat derived from below would have warmed the walls and contents of the lode, so as to raise their temperature above that which would naturally belong to the rocks at corresponding levels on each side of the lode. The almost entire absence of magnesium raises an obvious objection to the hypothesis of this spring deriving its waters from the sea; or if such a source be suggested for the salt and other marine products, we should be under the necessity of supposing the magnesium to be left behind in combination with some of the elements of the decomposed and altered rocks through which the thermal waters may have passed.

Hot springs are, for the most part, charged with alkaline and other highly soluble substances, and, as a rule, are barren of the precious metals, gold, silver, and copper, as well as of tin, platinum, lead, and many others, a slight trace of copper in the Bath waters being exceptional. Nevertheless, there is a strong presumption that there exists some relationship between the action of thermal waters and the filling of rents with metallic ores. The component elements of these ores may, in the first instance, rise from great depths in a state of sublimation or of solution in intensely heated water, and may then be precipitated on the walls of a fissure as soon as the ascending vapours or fluids begin to part with some of their heat. Almost everything, save the alkaline metals, silica, and certain gases, may thus be left behind long before the spring reaches the earth's surface. If this theory be adopted, it will follow that the metalliferous portion of a fissure, originally thousands of feet or fathoms deep, will never be exposed in regions accessible to the miner until it has been upheaved by a long series of convulsions, and until the higher parts of the same rent, together with its contents and the rocks which it had traversed, have been removed by aqueous denudation. Ages before such changes are accomplished, thermal and mineral springs will have ceased to act; so that the want of identity between the mineral ingredients of hot springs and the contents of metalliferous veins, instead of militating against their intimate relationship, is in favour of both being the complementary results of one and the same natural operation.

(To be continued.)

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2018. Edouard Andries, Schaerbeck, near Brussels, Belgium, "Improvements in means or apparatus for purifying every kind of water, and for rendering it drinkable, and for rendering sea water fresh and drinkable."

2026. Robert Thomson Monteith, St. Malo, France, "Improvements in preserving eggs."—Petitions recorded August 13, 1864.

2043. Peter Armand Lecomte de Fontainmoreau, Rue de la Fidélité, "Certain improvements in the process of preserving animal and vegetable alimentary substances."—A communication from François Xavier Escofet, Paris, France.—Petition recorded August 17, 1864.

2060. Henry Parkes, Birmingham, Warwickshire, "Improvements in the manufacture of colours for dyeing, printing, and other uses."

2063. Julius Thomsen, Copenhagen, Denmark, "Improvements in batteries for generating electricity, and in apparatus for converting the quantity thereof into intensity."—Petition recorded August 19, 1864.

2072. Francis Taylor, Romsey, Hampshire, "Improvements in apparatus for receiving, drying, and deodorising human excrement."—Petition recorded August 22, 1864.

2095. Richard Beard, jun., Clapham, and Walter Downing, Battersea, "Improvements in the manufacture of artificial leather, and in colouring, dyeing, or finishing the same, which latter improvements are also applicable to the colouring or dyeing of the ordinary leather cloth."—Petition recorded August 24, 1864.

2100. Richard Archibald Brooman, Fleet Street, London, "Improved apparatus for lighting and for firing charges in mines and other blasting operations."—A communication from Adolphe Dumas, Privas, France.—Petition recorded August 25, 1864.

2106. Henry Hathaway, Old Kent-road, and William Todd, Manor-street, Old Kent-road, "The application of a new material for the manufacture of paper, cardboard, millboard, papier mâché, and other similar substances."—Petition recorded August 26, 1864.

2126. John Sones, West Bromwich, Staffordshire, "Improvements in coating iron with steel."—Petition recorded August 30, 1864.

Notices to Proceed.

1031. Bounet Frederic Brunel, Brussels, Belgium, "Improvements in treating vegetable fibres, in converting them into pulp, in bleaching the same, and in apparatus employed therein."—Petition recorded April 23, 1864.

1058. Bounet Frederic Brunel, Brussels, Belgium, "Improvements in treating titanic iron sands, and in apparatus employed therein."—Petition recorded April 27, 1864.

1082. John McCall, Houndsditch, London, and Bevan George Sloper, Walthamstow, Essex, "Improvements in preparing and preserving food."—Petition recorded April 29, 1864.

1181. James Alfred Wanklyn, Finsbury Circus, "The manufacture of purple dye stuffs from manna-sugar."—Petition recorded May 10, 1864.

1686. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the smelting or reducing of lead ores, and in the refining and softening of lead."—A communication from Alexander Hill Everett, New York, U.S.A.

CORRESPONDENCE.

Copper Photography.

To the Editor of the Chemical News.

Sir,—In the last number of the *British Journal of Photography* there is an extract from the Chemical News, giving a short account of a recent observation of M. Renault on the action of light on sub-chloride of copper. I beg to refer your readers to the *Photographic News* of October 7, 1859, page 59, and to the *Mechanic's Magazine* of September 23, 1859, page 199, wherein it will be found that I made the discovery five years ago. I am the more particular of this on two accounts—first, because I consider the discovery a very valuable one, and secondly, because it was original, and one does not make original discoveries so frequently and so easily that one can afford to lose the merit attached thereto. I am, &c.

Collin Smart.

Sunderland.

MISCELLANEOUS.

A Monster Gun in America.—Dr. Draper, of New York, writes to the *Journal of Science* (in an article on the "Progress of Science in America"):—A 22-inch gun has been recently successfully cast at Pittsburg on Rodman's principle. In order to make this monster piece of ordnance, which will throw a solid shot of 1000 pounds, 104 tons of metal were melted, though the gun will only weigh, when finished, 56 tons. The essential feature of this system of casting is to cool the iron mass from the interior by means of a stream of water, which is sent to the bottom of the bore in a properly protected pipe, while the exterior is kept hot by a fire round it. In this instance air was substituted for the water after a certain length of time, as the water was found to lower the temperature of the metal too quickly. The running of the iron occupied only 21½ minutes, and the gun was ready for the lathe in a fortnight. These hollow-cast guns are also very durable, the 25-inch at Fortress Monroe having been already fired 505 times.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E C.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. IX. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. X. commenced on July 2, 1864, and will be complete in 26 numbers.

S. S.—Received with thanks. The translation of Mr. Graham's letter shall appear next week.

Received.—P. C.; W. B.: Reader; Salicine; Dr. Adriani. Answers will appear next week.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Revision of the Mineral Phosphates, by A. H. Church, *M.A., Professor of Chemistry, Royal Agricultural College, Cirencester.*

No. I.—Delvauxite.

I purpose commencing a series of notes upon the hydrous mineral phosphates by some account of experiments with delvanxite. I have indicated the older atomic weights by italics—for those of Gerhardt the ordinary type is used :—

In Dana's "Mineralogy," (fourth edition, 1855, p. 427) the formula $2Fe_2O_3.PO_5+24HO$ is assigned to delvanxite. This agrees well enough with the experimental percentages of ferric oxide and phosphoric anhydride obtained by MM. Delvaax and Dumont, but it requires 48·3 per cent. of water, while the analytical results varied between 41·13 and 49·76 per cent. of water; no mention is made of calcium as an essential constituent of the mineral—

Fe_4O_3	P_2O_5	H_2O		
34·20	16·04	49·76	= 100·	Dumont.
40·44	18·20	41·13	= 99·77	Delvaux.

From the latter analysis M. Delvaux deduces the formula—$2Fe_2O_3PO_5+18HO$. But other expressions have also been proposed.

Delvauxite was analysed by C. V. Haner in 1854*. The two specimens he examined, though from different localities, gave identical results. One specimen, from the same locality whence the mineral analysed by MM. Delvaux and Damont was obtained, lost 12·2 per cent of water at 100°, and by ignition suffered a further loss of 13·84 per cent.—in all 26·04 per cent. Dried over chloride of calcium it still retained 17·02 per cent. of water. Deducting 2·08 per cent. of silica, C. von Haner obtained the following percentages by operating on the mineral dried over chloride of calcium :—

Fe_4O_3	Ca_2O	P_2O_5	H_2O	
52·03	7·94	20·93	19·08	=99·98

Hence he deduces the formula—

$$2CaO,PO_5+5Fe_2O_3,PO_5+16HO$$

From these conflicting results it is difficult to draw any satisfactory conclusions as to the real formula of the mineral. If chemists had invariably analysed natural phosphates in the same manner as the preparations of the laboratory, the discrepancies in the above results could scarcely have occurred. Many other hydrous mineral species are in an exactly similar predicament—the hygrometric condition at the time of analysis has not been determined. In the case of delvauxite I have just completed a series of experiments with especial reference to this question.

The finely-powdered substance was first exposed in vacuo over sulphuric acid till it ceased to lose weight—

Substance taken	31·055	grains
After four hours' drying . .	27·47	,,
After eight hours' drying . .	24·74	,,
After ten hours' drying. . .	24·74	,,

The loss of water, when the substance had ceased to alter in weight, was thus 6·315 grains = 20·33 per cent. The mineral thus far dried, when heated to 100° suffered a further loss, which, when the weight had become constant, amounted to 1·84 grains, or 5·93 per cent. In delvauxite, then, the water driven off by heating the mineral to 100°, amounts to 26·26 per cent.

The next experiments were made in order to determine the total amount of water in the mineral. On ignition of the powdered delvaoxite, it loses the whole of its water, a trace of carbonic acid gas escaping also; the colour changes, approaching very closely in tint a pigment known as "Mars Violet." The loss on ignition, which may be taken as water only, is considerable, but gives a different result from that obtained in earlier analyses.

1. Substance taken . .	20·7	grains.	
After ignition it weighed	13·0	,,	
H_2O lost . . .	7·7	,,	or 37·198 p.c H_2O.
2. Substance taken . .	16·1	,,	
After ignition it weighed	10·1	,,	
H_2O lost . . .	6·	,,	or 37·27 p.c. H_2O.

The sample of delvanxite, then, submitted to analysis contained originally 37·234 per cent. of water; of this 20·33 per cent. was lost by simple exposure to the ordinary temperature in vacuo in presence of oil of vitriol. The ratio of phosphoric anhydride to ferric oxide having been already determined with exactness, there remained to be learnt the formula which expresses most accurately the constitutional water of delvauxite after the hygroscopic and accidental water has been removed. Accepting the formula $2Fe_2PO_4+Fe_4O_3$ for ignited delvauxite, we are led to the following conclusions :—

Pure delvanxite free from hygroscopic moisture has the formula Fe_2PO_4 + aq. + $Fe_2H_3O_3$; which demands 16·31 per cent. H_2O. Experiment gave 16·904 per cent. H_2O.

Delvauxite dried at 100° has the formula—

$$Fe_2PO_4 + Fe_2H_3O_3;$$

which demands 10·46 per cent. H_2O. Experiment gave 10·974 per cent. H_2O.

A word or two in conclusion as to the ferric oxide and phosphoric anhydride of delvauxite. Let us revert to the analysis by MM. Dumont and Delvaax, above given, excluding, however, all the water :—

Fe_4O_3	P_2O_5	
68·15	31·85	Re-calculated percentages in M. Dumont's and in M. Delvaax's analysis.
68·99	30·78	
69·26	30·74	Theoretical percentage corresponding to the formula—$2Fe_2PO_4 + Fe_4O_3$.

A closer accordance between experiment and theory could scarcely be expected; further analyses, though unnecessary, have, however, amply confirmed the above results, which, it will be seen, refer to the anhydrous ignited mineral.

My specimen of delvanxite (from Liège) contains a mere trace of calcium. It leaves after treatment with hydrochloric acid and ignition a residue of silicic acid amounting to 1·67 per cent. If due allowance were made for this, the percentages of water obtained in the analysis would approach still closer to those required by theory.

Delvauxite dissolves in cold hydrochloric acid. The solution evaporated to complete dryness leaves a yellowish brown mass, from which water extracts the ferric chloride, the white ferric phosphate remaining insoluble.

My results may be thus given :—

1. Delvauxite contains a large and varying amount of hygroscopic water, so that the formulæ of Dana, and of Odling ("Chemistry," p. 309), represent a substance more or less wet.

2. Delvauxite dried in vacuo over sulphuric acid retains a constant amount of water—is a combination of

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* *J. pr. Chemie*, lxiii., 15.

ferric phosphate with ferric hydrate. The H_2O belongs most probably to the former salt; thus:—

$$\left.\begin{matrix}Fe_2PO_4 + aq.\\ Fe_2H_3O_3\end{matrix}\right\}.$$

3. Delvauxite dried at 100° has the formula

$$Fe_2PO_4 + Fe_2H_3O_3.$$

4. Ignited delvauxite has the formula

$$2Fe_2PO_4 + Fe_4O_3.$$

Researches on the Respiration of Flowers,
by M. AUG. CAHOURS.

WHILE the green portions of plants under the influence of light effect the decomposition of carbonic acid, of which they assimilate the carbon, rejecting the oxygen into the atmosphere, the coloured parts, on the contrary, consume the oxygen to produce carbonic acid. Thus, by one of nature's most admirable harmonies, the atmosphere does not, after ages, become sensibly modified.

But if experiment has long since proved that flowers left in atmospheric air develope carbonic acid at the expense of the oxygen it contains, it is, nevertheless, interesting to determine the modifications presented by this phenomenon under varying circumstances.

Now, do all flowers of equal weight, or of equal surface, consume, under identical circumstances, the same quantity of oxygen, and produce the same proportion of carbonic acid? Do scented flowers behave in the same way as those which are scentless? Does the same flower act more energetically on an atmosphere determined under the influence of a more or less vivid light than in perfect darkness? Is the consumption of oxygen proportionate to the temperature of the medium in which the flower respires? Does a plant consume the same quantity of oxygen at each period of its development? Finally, what do the various parts of the plant —the calyx, corolla, pistil, stamens—respectively play? Such are the questions I propose to resolve.

If we experiment on various flowers of equal weight, arrived at the same state of development, it is easy to ascertain, by operating under perfectly identical conditions, that the respective consumption of oxygen in a given time is far from being the same. As to the more or less powerful odour exhaled by the plant, it seems to play but a trifling part in the production of this phenomenon; in fact, a scentless, or nearly scentless, flower consumes, in a given time, more oxygen than a strongly scented one. Results obtained at the beginning of these researches led me at first to suppose that scented flowers absorbed atmospheric oxygen more rapidly; but later and multiplied experiments on various flowers have shown me that this view could not be established as a general conclusion.

On the other hand, I am convinced that, other things being equal, though the proportion of carbonic acid formed is generally rather greater when the flower is exposed to the light than when it is in perfect darkness, the difference is far from being so great as is supposed. This difference becomes much more manifest when the normal air is replaced by pure oxygen.

When the phenomenon takes place in ordinary air, it is not unusual to find that the results are the same, whether obtained in darkness or in a bright light. This result is very different to those obtained with most organic substances, which, enclosed in equal weights in tubes containing equal volumes of atmospheric air, consume much more oxygen in light than in darkness. The differences observable under these circumstances may probably be accounted for, in the one case, by the bodies undergoing change being possessed of more or less energetic vitality, and in the other being entirely inert.

In operating on the same plant either in complete darkness or in the light, it is found that as the temperature is raised the proportion of carbonic acid produced in a given time is very appreciably augmented. This result is observable in the most various flowers. When the outer temperature varies from + 15 to + 25°, the transformation of oxygen into carbonic acid is rapid; but with temperatures between + 5 and + 10° it is, on the contrary, slow.

The plant does not consume the same quantity of oxygen at different periods of its development, nor produce the same proportion of carbonic acid. Such is the result of a large number of comparative experiments. The differences are, nevertheless, not very considerable. By gathering from the same plant exactly equal weights of buds and full-blown flowers, and placing them respectively in equal volumes of normal air under identical conditions of light and temperature, the consumption of oxygen is almost always slightly greater with the buds than with the full-blown flowers,—a result which is not surprising when we consider that the vital force is greater in the first than in the second instance; still, the difference is never very striking.

Now, all plants being composed of several distinct parts, it may be asked, "What part is taken by each portion in the production of the phenomenon?" To ascertain this, it is necessary to anatomise the flower—to isolate its various parts, to study the part each plays—by putting them respectively in contact with known volumes of normal air—taking their respective weights into consideration—and comparing the results given by the various parts, with the general results derived from the entire plant, the experiment being, moreover, effected under perfectly identical circumstances.

By operating thus on flowers with sufficiently developed pistil and stamens, the weight of which is not a fraction too small for that of the entire flower and the corolla, such as the oriental poppy, the field coquelicot, the coquelicot with large bracts, the lily, the water lily, &c., I found that on comparing the proportion of carbonic acid furnished by the corolla with that given, under the same conditions, by the pistil and stamens, there was a great difference in favour of the latter—a result which might, indeed, have been expected.

Finally, independently of the carbonic acid formed by the combustion of the elements of the flower at the expense of atmospheric oxygen, this gas itself disengages a certain proportion, as may be ascertained by leaving the flowers in an apparatus containing inert gases, such as hydrogen or nitrogen.

In conclusion, I summarise thus:—

1. That all flowers left in a limited atmosphere of normal air consume oxygen and produce carbonic acid in proportions varying as the flower is scentless or not.

2. That the circumstances under which the phenomenon takes place being identical, the proportion of carbonic acid increases as the temperature is raised.

3. That generally with flowers from the same plant and of equal weight the quantity of carbonic acid produced is rather greater when the apparatus in which the experiment is performed is exposed to the light than when it is in darkness; that the proportion is, nevertheless, sometimes the same under either condition.

4. That when the normal air is replaced by pure oxygen the differences become much more marked.

5. That buds produce rather more carbonic acid than

fully-developed flowers, which is explicable by the greater vitality of the buds.

6. That flowers left in inert gas disengage small quantities of carbonic acid.

7. Finally, the pistil and stamens, which possess the greatest vitality of any part of the flower, consume the greatest quantity of oxygen and produce the largest proportion of carbonic acid.—*Comptes Rendus*, lviii., 1206. 64.

EXAMINING BOARDS.

(Continued from page 140.)

SCOTLAND.

THE Scottish Schools open on November 1.

UNIVERSITY OF EDINBURGH.

Professor of Chemistry.—Dr. Lyon Playfair, C.B., F.R.S.

ROYAL COLLEGES OF PHYSICIANS AND SURGEONS, EDINBURGH.

The following Courses of Lectures in connection with these Colleges are delivered:—

Chemistry (School of Arts, Adam Square), 10 a.m., Dr. Stevenson Macadam; Practical Chemistry and Analytical Chemistry, 9 a.m. till 5 p.m., Dr. Stevenson Macadam (at Surgeons' Hall); Chemistry (4, High School Yards), 11 a.m., Dr. A. C. Brown; Practical Chemistry and Analytical Chemistry, 9 a.m. till 5 p.m., Dr. A. C. Brown (4, High School Yards).

Practical Chemistry, 3*l.* 3s.; Analytical Chemistry, 2*l.* a month, 5*l.* for three months, or 10*l.* for the Session of six months.

Practical and Analytical Chemistry, Dr. Stevenson Macadam (at Surgeons' Hall); Practical and Analytical Chemistry, Dr. A. C. Brown (4, High School Yards).

UNIVERSITY OF GLASGOW.

Professor of Chemistry.—Thomas Anderson, M.D., F.R.S.E., F.C.S., &c.

Assistants.—Edmund J. Mills, B.Sc., F.C.S., tutor; Magnus M. Tait, F.C.S.; William A. Dixon, F.C.S.; Walter Stewart.

The Courses of Chemical Instruction given by Dr. Anderson are intended to afford to the Student the means of acquiring a thorough knowledge of the Science of Chemistry, and its applications to Medicine and the different branches of the useful arts.

In addition to the Lectures, the class is divided into small sections, which meet separately, and receive tutorial instruction from Mr. Mills.

At certain periods during the Course, written exercises are prescribed, some to be done at home and others in the lecture-room, and without the aid of books or notes.

The Course of Practical Instruction in the Laboratory is arranged in such a manner as to lead the Student through a complete series of Analytical operations.

The fundamental instructions are the same for every pupil, whatever may be the ultimate object of his studies; but after he has acquired a competent knowledge of the general methods of analysis, and a sufficient amount of practical skill, the course for each student diverges into the particular department of the science, or its practical application to Medicine, Agriculture, or the Manufacturing Arts, which he may desire to prosecute.

Students can enter the Laboratory at any time throughout the year.

The Laboratory Fee is 4*l.* 4s. for three months; for the Course of Lectures, 3*l.* 3s.

ANDERSON'S UNIVERSITY, GLASGOW.

Professor of Chemistry.—Dr. Penny.

The Winter Course of Scientific Lectures on Chemistry will be commenced on Tuesday, November 1, at 10 a.m.

Instruction in Practical Chemistry and Analysis in the Laboratory, daily from 11 till 4.

The Private Laboratory for Commercial Analyses and Assays is open daily throughout the year.

Evening Course of Popular Lectures on Inorganic Chemistry, with special reference to the Industrial Arts, on Fridays, commencing November 4, at 8.30.

Evening Course of Practical Chemistry, on Thursdays, at 7.

GLASGOW MECHANICS' INSTITUTION.

Lecturer on Chemistry.—Dr. Wallace, F.R.S.E., F.C.S.

Assistants.—William Younger and George Gatherall.

The Laboratory is open daily, Saturdays excepted, for instruction in Practical and Analytical Chemistry as applied to the Arts, Manufactures, Mining, and Agriculture. Students may join at any time throughout the year. Fee for six months, 10*l.* 10s.

A Course of Lectures on Chemical Technology will be commenced on Tuesday, October 4, at half-past 8 p.m.

An Evening Practical Class for Students connected with Mining and Metallurgical operations will be commenced on Wednesday, November 2, at half-past 7 p.m.

LABORATORY AND LECTURE ROOM, 108, INGRAM STREET, GLASGOW.

A. T. Machattie, Ph.D., F.C.S.

Daily Lectures on Chemistry.—Six months' Course. Fee 2*l.* 2s. Beginning on Tuesday, November 1, at 10 a.m.

Analytical Chemistry.—Daily from 9 a.m. till 5 p.m., beginning November 1.

These Classes qualify for the various Medical and Public Boards.

EVENING CLASSES.—*Course of Twenty-five Lectures on Inorganic Chemistry* in the Lecture-hall of the Glasgow Athenæum, on Tuesday evenings at 8, beginning on November 1. The Laboratory is open on Wednesdays and Thursdays, from 7 till 9 p.m., for instruction in Analytical and Practical Chemistry.

EVENING SCIENCE CLASSES. CARLTON PLACE SECULAR SCHOOL, GLASGOW.

Teacher.—John Mayer, F.C.S.

Chemistry and Metallurgy, especially with the view of passing the Examinations of the Society of Arts and the Government Department of Science and Art.

Lectures on Tuesday and Thursday, at 8 p.m.

ABERDEEN.

Chemistry.—Professor Brazier.

ST. ANDREWS.

Chemistry.—M. Foster Heddle, M.D.

IRELAND.

DUBLIN.—TRINITY COLLEGE.

Professor of Chemistry.—Dr. J. Apjohn.

The Laboratory is open through the year.

CATHOLIC UNIVERSITY.

Professor of Chemistry.—Dr. W. K. Sullivan.

CARMICHAEL SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Dr. Davy.

Practical Chemistry in the summer.

LEDWICH SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Dr. Cameron.
Practical Chemistry in the summer.

ROYAL COLLEGE OF SURGEONS.

Lecturer on Chemistry.—Dr. Barker.
Laboratory open throughout the year.

QUEEN'S COLLEGE, BELFAST.

Professor of Chemistry.—Dr. Andrews.

QUEEN'S COLLEGE, CORK.

Professor of Chemistry.—Dr. Blyth.

QUEEN'S COLLEGE, GALWAY.

Professor of Chemistry.—Dr. T. H. Rowney.

A Laboratory for practical instruction is attached to all the Queen's Colleges. The usual Practical Course for the Medical Boards is given in the summer. The Winter Session in Ireland commences at November.

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION.

Address by Sir Charles Lyell, *Bart., LL.D., D.C.L., F.R.S., &c., President. (Delivered before the Members of the Association at Bath, September 14, 1864.)*

(Continued from page 144.)

But there are other characters in the structure of the earth's crust more mysterious in their nature than the phenomena of metalliferous veins, on which the study of hot springs has thrown light—I allude to metamorphism of sedimentary rocks.

Various experiments have led to the conclusion that the minerals which enter most largely into the composition of the metamorphic rocks have not been formed by crystallising from a state of fusion, or in the dry way, but that they have been derived from liquid solutions, or in the wet way—a process requiring a far less intense degree of heat. Thermal springs, charged with carbonic acid and with hydro-fluoric acid (which last is often present in small quantities), are powerful causes of decomposition and chemical reaction in rocks through which they percolate. If, therefore, large bodies of hot water permeate mountain-masses at great depths, they may in the course of ages superinduce in them a crystalline structure; and in some cases strata in a lower position and of older date may be comparatively unaltered, retaining their fossil remains undefaced, while newer rocks are rendered metamorphic. This may happen where the waters, after passing upwards for thousands of feet, meet with some obstruction, as in the case of the Wheal Clifford spring, causing the same to be laterally diverted so as to percolate the surrounding rocks. The efficacy of such hydro-thermal action has been admirably illustrated of late years by the experiments and observations of Sénarmont, Daubrée, Delesse, Scheerer, Sorby, Sterry Hunt, and others.

The changes which Daubrée has shown to have been produced by the alkaline waters of Plombières, in the Vosges, are more especially instructive. These thermal waters have a temperature of 160° F., and were conveyed by the Romans to baths through long conduits or aqueducts. The foundations of some of their works consisted of a bed of concrete made of lime, fragments of brick, and sandstone. Through this and other masonry the hot waters have been percolating for centuries, and have given rise to various zeolites—apophyllite and chabazite among others; also to calcareous spar, arragonite, and fluor spar, together with siliceous minerals, such as opal—all found in the interspaces of the bricks and mortar, or constituting part of their rearranged materials. The quantity of heat brought into action in this instance in the course of 2000 years has, no doubt, been enormous, although the intensity of it developed at any one moment has been always inconsiderable.

The study, of late years, of the constituent parts of granite has in like manner led to the conclusion that their consolidation has taken place at temperatures far below those formerly supposed to be indispensable. Gustav Rose has pointed out that the quartz of granite has the specific gravity of 2·6, which characterises silica when it is precipitated from a liquid solvent, and not that inferior density, namely 2·3, which belongs to it when it cools and solidifies in the dry way from a state of fusion.

But some geologists, when made aware of the intervention on a large scale, of water, in the formation of the component minerals of the granitic and volcanic rocks, appear of late years to have been too much disposed to dispense with intense heat when accounting for the formation of the crystalline and unstratified rocks. As water in a state of solid combination enters largely into the aluminous and some other minerals, and therefore plays no small part in the composition of the earth's crust, it follows that, when rocks are melted, water must be present, independently of the supplies of rain-water and sea-water which find their way into the regions of subterranean heat. But the existence of water under great pressure affords no argument against our attributing an excessively high temperature to the mass with which it is mixed up. Still less does the point to which the melted matter must be cooled down before it consolidates or crystallises into lava or granite afford any test of the degree of heat which the same matter must have acquired when it was melted and made to form lakes and seas in the interior of the earth's crust.

We learn from Bunsen's experiments on the Great Geyser, in Iceland, that at the depth of only seventy-four feet, at the bottom of the tube, a column of water may be in a state of rest, and yet possess a heat of 120° Centigrade, or 248° F. What, then, may not the temperature of such water be at the depth of a few thousand feet? It might soon attain a white heat under pressure; and as to lava, they who have beheld it issue, as I did in 1858, from the south-western flanks of Vesuvius, with a surface white and glowing like that of the sun, and who have felt the scorching heat which it radiates, will form a high conception of the intense temperature of the same lava at the bottom of a vertical column several miles high, and communicating with a great reservoir of fused matter, which, if it were to begin at once to cool down, and were never to receive future accessions of heat, might require a whole geological period before it solidified. Of such slow refrigeration hot springs may be among the most effective instruments, abstracting slowly from the subterranean molten mass that heat which clouds of vapour are seen to carry off in a latent form from a volcanic crater during an eruption, or from a lava-stream during its solidification. It is more than forty years since Mr. Scrope, in his work on volcanoes, insisted on the important part which water plays in an eruption, when intimately mixed up with the component materials of lava, aiding, as he supposed, in giving mobility to the more solid materials of the fluid mass. But when advocating this igneo-aqueous theory, he never dreamt of impugning the Huttonian doctrine as to the intensity of heat which the production of the unstratified rocks, those of the plutonic class especially, implies.

The exact nature of the chemical changes which hydro-thermal action may effect in the earth's interior will long remain obscure to us, because the regions where they take place are inaccessible to man; but the manner in which volcanoes have shifted their position throughout a vast series of geological epochs—becoming extinct in one region and breaking out in another—may, perhaps, explain the increase of heat as we descend towards the interior, without the necessity of our appealing to an original central heat or the igneous fluidity of the earth's nucleus.

We have omitted those portions of the President's Address which do not particularly relate to chemistry or physical science, and now proceed to give the opening address, by Dr. Odling, before the Chemical Section.

SECTION B.—CHEMICAL SCIENCE.

President.—W. Odling. M.B., F.R.S., F.C.S.

Vice-Presidents.—Sir B. C. Brodie, Bart, F.R.S.; C. G. B. Daubeny, M.D., F.R.S.; J. H. Gladstone, Ph.D., F.R.S.; A. W. Williamson, Ph.D., F.R.S.

Secretaries.—Professor Liveing, M.A., F.C.S.; A. Vernon Harcourt, M.A., F.C.S.; Robert Biggs.

Committee.—F. A. Abel, F.R.S.; Dr. Attfield, F.C.S.; A. R. Catton; H. Deane, F.L.S.; B. Edwards, Ph.D.; J. P. Gassiot, F.R.S.; E. A. Hadow, F.C.S.; G. W. Knox, B. Sc.; S. Macadam, F.R.S.E.; H. M. Noad, Ph D., F.R.S.; B. H. Paul, Ph.D.; Professor Roscoe; H. C. Sorby, F.R.S.; C. Tomlinson; Professor Tennant; Professor Voelcker; R. Warrington, F.R.S.; P. Worsley.

Thursday, September 15, 1864.

The PRESIDENT, on rising to deliver his opening address, was received with applause. He said:—

At the Leeds meeting of the British Association in 1858, Sir John Herschel, the then president of the chemical section, opened its proceedings with an introductory address of singular interest, and thereby established a precedent which, with a single exception, has been uniformly followed by successive occupants of the position which I have now the honour to hold. Following in his footsteps *longo intervallo*, I in my turn now venture upon a few words of introduction to the proper business that we have in hand. In the first place, I may congratulate the section upon the presence among us of so many distinguished chemists, including several of my more immediate predecessors. I need scarcely express the personal gratification I feel at meeting them here, nor say how much their presence relieves me from the feeling of responsibility and self-mistrust with which I undertook the honourable office so kindly entrusted to me by the committee, feeling now that upon every occasion of difficulty I shall have them to apply to for counsel and assistance.

After the great diversity, or rather antagonism, of opinion which has existed for the last dozen years or so, I am almost bound to take a somewhat prominent notice of the substantial agreement which now prevails among English chemists as to the combining proportions of the elementary bodies, and the molecular weights of their most important compounds. The present unanimity of opinion on this fundamental subject among those who have given it their attention is, I conceive, greater than has ever been the case since Dalton published his New System of Chemical Philosophy more than half a century ago. As yet, indeed, the unanimity of practice falls considerably short of the unanimity of belief, but even in this direction great progress is being made, to which the publication of Miller's "Elements of Chemistry," Watt's "Dictionary of Chemistry," and Hofmann's "Jury Report on the Chemical Products in the Great Exhibition," will doubtless give a yet stronger impetus. As was well observed by Dr. Miller at a previous meeting of this Association, "Chemistry is not merely a science, it is also an art which has introduced its nomenclature and its notation into our manufactories, and in some measure even into our daily life." Hence the great difficulty of effecting a speedy change in chemical usages alike so time honoured and intimately ramified. I propose, with your permission, to make a few remarks upon the history of this chemical reformation, more especially in connection with certain points which some of its most distinguished leaders have scarcely, I think, correctly estimated.

From the time when Dalton first introduced the expression "atomic weight," up to the year 1842, when Gerhardt announced his views upon the molecular constitution of water, there does not seem to have been any marked difference of opinion among chemists as to the combining proportions of the principal elements. That 1 part by weight of hydrogen, united with 36 parts by weight of chlorine to form a single molecule of hydrochloric acid, and with 8 parts by weight of oxygen to form a single molecule of water, was the notion both of Berzelius and Gmelin, who may be taken as representatives of the two chief Continental schools of theoretic chemistry. There was, indeed, no difference of opinion whatever between them as to the combining proportions of the three elements. Using the hydrogen scale of numbers, both chemists represented the combining proportion of hydrogen as 1, that of chlorine as 36, and that of oxygen as 8. Both, moreover, represented the molecular weight of hydrochloric acid as 37, and the molecular weight of water as 9. True it is that Berzelius professedly regarded the single combining proportions of hydrogen and chlorine as consisting each of two physical atoms; but since the two atoms of hydrogen, for instance, which constitute the one combining proportions of hydrogen, were chemically inseparable from one another, they were really tantamount to one atom only of hydrogen, and, as a matter of fact, were always employed by Berzelius as representing the single chemical atom of hydrogen, or its smallest actual combining proportion.

Distinguishing thus, between the physical atom and the combining proportion, Berzelius' recognition of the truth that equal volumes of the elementary gases contain an equal number of atoms was utterly barren. But identifying the physical atom with the combining proportion, Gerhardt's recognition, or rather establishment of the broader truth, that equal volumes of all gases, elementary and compound, contain the same number of atoms, has been in the highest degree prolific. From Gerhardt's division of volatile bodies into a majority whose recognised molecules corresponded respectively with four volumes of vapour, and a minority, whose recognised molecules corresponded respectively with but two volumes; and from his proposal, in conjunction with Laurent, to double the molecular weights of these last, so as to make the molecules of all volatile bodies, simple and compound, correspond each with four volumes of vapour, must, I conceive, be traced the development by himself and others of the matured views on chemical philosophy which now prevail. With every respect for my predecessor in this chair, and for the accomplished author of the "Leçons de Philosophie Chimique," from neither of whom do I ever venture to differ without fear and trembling, I cannot join with them in regarding the initiation of Gerhardt's system as an imperfect return, and its remarkable maturation in these recent days as a more complete return to the notions of Berzelius. It is true that the elementary weights now employed, with the exception of those for some half-dozen metals, are identical with the atomic weights of Berzelius, but so different are they from his combining weights, that fully four-fifths of all known compounds have to be expressed by formulæ entirely different from his; namely, all those bodies, with but a very few exceptions, into which hydrogen, fluorine, chlorine, bromine, iodine, nitrogen, phosphorus, arsenic, boron, and the metals lithium, sodium, potassium, silver, and gold, enter as constituents. Fully admitting that the new system of atomic weights, as it now exists, is the joint product of many minds, fully admitting that it owes its present general acceptance chiefly to the introduction of the water type by Williamson during Gerhardt's lifetime, and the recognition of diatomic metals by Würtz and Cannizzaro after his decease, and fully admitting, moreover, that some of Gerhardt's steps in the development of his unitary system were decidedly, though perhaps excusably, retrograde, I yet look upon him, not I trust with the fond admiration of the pupil, but the calm judgment of the chemist, as being the great founder of that modern chemical philosophy, in the general spread of which I have already ventured to congratulate the members of the section.

Prior to the time of Gerhardt, the selection of molecular weights for different bodies, elementary and compound, had been almost a matter of hazard. Relying conjointly upon physical and chemical phenomena, he first established definite principles of selection, by pointing out the considerations upon which the determination of atomic weights must logically depend. Relying upon these principles, he established his classification of the non-metallic elements into monohydrides represented by chlorine; dihydrides represented by oxygen; terhydrides represented by nitrogen, &c.; and relying upon the same principles, but with a greatly increased knowledge of phenomena, later chemists have given to his method a development and unity, more especially as regards the metallic elements, which have secured for the new system the impregnable and acknowledged position which it at present occupies. The comparative unanimity which prevailed before the time of Gerhardt was the unanimity of submission to authority, but the greater unanimity which new prevails is the unanimity of conviction, consequent upon an intermediate period of solitary insurrection, general disturbance and ultimate triumph.

Bearing in mind how much the origin of the new system by Gerhardt, and its completion by his colleagues and disciples are due to a correct appreciation of the harmony subsisting between chemical and physical relations, we cannot but give a hearty welcome to any large exposition of mixed chemico-physical phenomena; and whether or not we agree with all his conclusions, there can be but one opinion as to the obligation chemists are under to Professor Kopp, of Giessen, for the great addition he has recently made to our knowledge, and means of obtaining a further knowledge of what has hitherto been but a very limited subject—namely, specific heat.

The agreement of chemists as to the elemental atomic weights is tantamount to an agreement among them as to the relative quantities of the different kinds of matter which shall be represented by the different elemental symbols, and this brings me to the subject of chemical notation. At one time many chemists, even of considerable eminence, believed and taught that Gerhardt's reformation had reference mainly to notation, and not to the association and interpretation of phenomena, and it became rather a fashion among them to declaim against the puerilities of notational questions. That the idea is of far greater importance than the mode of expressing it is an obvious truism; but, nevertheless, the mode of expression has an importance of its own as facilitating the spread of the idea, and more especially its development and procreation. It has been well asked, in what position would the science of arithmetic have been but for the substitution of Arabic for Roman numerals, the notation in which value is expressed by the change in position for that in which it is expressed mainly by the repetition of a few simple signs.

It is unfortunately too true that chemical notation is at present in anything but a satisfactory state. The much-used sign of addition is, I conceive, about the last one would deliberately select to represent the fine idea of chemical combination, which seems allied rather, I should say, to an interpenetration than to a coarse apposition of atoms. The placing of symbols in contiguity, or simply introducing a point between them, as indicative of a sort of multiplication or involution of the one atom into the other, is, I think, far preferable; but here, as pointed out by Sir John Herschel, we violate the ordinary algebraic understanding, which assigns very different numerical value to the expressions xy and $x + y$ respectively. I know, indeed, that one among us has been engaged for some years past in conceiving and working out a new and strictly philosophical system of chemical notation by means of actual formulæ, instead of mere symbols, and I am sure that I only express the general wish of the section when I ask Sir Benjamin Brodie not to postpone the publication of his views for a longer time than is absolutely necessary for their sufficient elaboration.

In any case, however, the symbolic notation at present employed, with more or less modification of detail, must continue to have its peculiar uses as an instrument of interpretation, and hence the importance of our endeavouring to render it more precise in meaning and consistent in its application. Many of its incongruities belong to the very lowest order of convention; such, for example, as the custom of distinguishing between the representation of so-called mineral and organic compounds, one particular sequence of symbols being habitually employed in representing the compounds of carbon, and an entirely different sequence of symbols in representing the more or less analogous compounds of all other elements. Now that organic and mineral chemistry are properly regarded as forming one continuous whole, a conclusion to which Kolbe's researches on sulphuretted organic bodies have largely contributed, it is high time that such relics of the ancient superstition, that organic and mineral chemistry were essentially different from one another, should be done away with.

Although during the past year the direct advance of that crucial organic chemistry, the synthesis of natural organic bodies, has not been striking, yet, on the other hand, its indirect advance has, I submit, been very considerable. Several of the artificially produced organic compounds at first thought to be identical with those of natural origin, have proved to be, as is well known, not identical, but only isomeric therewith. Hence, *reculer pour mieux sauter*, chemists have been stepping back a little to examine more intimately the construction both of natural organic bodies and of their artificial isomers. The synthetic power having been attained of putting the bricks together in almost any desired way, it is yet necessary, in order to construct some particular biological product, to first learn the way in which its constituent bricks have been naturally put together. We accordingly find the study of isomerism, or what comes to the same thing, the study of the intimate construction of the bodies, is assuming an importance never before accorded to it. Isomerism is, in fact, the chemical problem of the day, and concurrently with its rapidly advancing solution, through the varied endeavours of many workers, will be the advance in rational organic synthesis.

It is curious to note the oscillations of opinion in reference to this subject. Twenty years ago the molecular constitution of bodies was perceived by a special instinct simultaneously with, or even prior to, the establishment of their molecular weights. Then came an interval of scepticism, when the intimate constitution of bodies was maintained to be not only unknown, but unknowable. Now, we have a period of temperate reaction not recognising the desired knowledge as unattainable, but only as difficult of attainment. And in this, as in many other instances, we find evidence of the healthier state of mind in which now more perhaps than ever the first principles of chemical philosophy are explored. Speculation, indeed, is not less rife, and scarcely less esteemed than formerly, but is now seldom or never mistaken for ascertained truth. Scepticism, indeed, still prevails, not, however, the barren scepticism of contentment, but the fertile scepticism which aspires to greater and greater certainty of knowledge.

Chemical science is advancing, I believe, not only more rapidly, but upon a surer basis than heretofore; and while, with every advance, the prospect widens before our eyes, so that we become almost alarmed at contemplating what those who come after us will have to learn, we console ourselves with the determination that their labour of unlearning shall be as little as possible, far less, we hope, than what we in our time have had to experience.

At the conclusion of the President's address the following papers were read[*] :—

Dr. Gladstone—*Report of the Committee on the Application of Gun-cotton to Warlike Purposes.*

Dr. Miller—*On the Analysis of a Hot Spring containing Lithium and Cæsium in Wheal Clifford.*

Dr. Daubeny—*On the Bath Waters.*

Dr. Paul—*Note on Some of the Constituents of the Oil known as Crude Paraffin Oil.*

Friday, September 16, 1864.

On Friday the following papers were read in Section B :

Rev. G. F. Browne—*On the Prismatic Formation of Ice.*

A. R. Catton—*On the Direct Conversion of Acetic Acid into Butyric and Caproic Acids.*

Dr. W. Bird Herapath—*On a New Method of Discovering the Hydrogen Compounds of Arsenic, Sulphur, Antimony, and Phosphorus when in Company as a Mixed Gas.*

Dr. T. Anderson—*On some Bituminous Substances.*

Stewart Clark—*Description of an Apparatus for Estimating the Organic Impurities in Atmospheric Air and in Water.*

Dr. Stevenson Macadam—*On the Pollution of Rivers by the Sewage of Towns.*

Dr. Henry Bird—*On the Utilisation of Sewage.*

A deputation from the Chemical Section also attended this morning in Section F, (Economic Science and Statistics), when Mr. James Heywood read a *Report of a Committee of the British Association on Uniformity of Weights and Measures.*

On Friday evening Professor Roscoe delivered a lecture in the Theatre on *The Chemical Action of Light.*

Saturday, September 17, 1864.

There was no meeting in Section B to-day, as a number of members of the Chemical Section of the British Association paid a visit to Bristol for the purpose of inspecting some of the principal manufactories. Amongst them were Dr. Odling, Chairman of the Section, Sir Benjamin Brodie, Professor Williamson, Professor Miller, Professor Roscoe, and other distinguished chemists, as well English as foreign. After going over Messrs. Finzel and Co.'s colossal sugar refinery at Counterslip, Messrs. Panter's lead works, Messrs. Powell's bottle works, &c., the visitors repaired to the works of Christopher Thomas and Brothers, the St. Philip's-plain soap works, where they were entertained at a handsome champagne luncheon. Having done justice to the good things provided for them, the visitors went over the works, being accompanied by the partners and by Mr. W. L. Carpenter, the intelligent chemist of the establishment.

Monday, September 19, 1864.

The following papers were read in Section B :—

A. R. Catton—*On the Molecular Constitution of Carbon Compounds.*

Maxwell Lyte—*On an Apparatus for the Preservation or Disengagement of Sulphuretted Hydrogen, Carbonic Acid, or Other Gases.*

W. Poole King—*On the Premature Decay of the Frescoes in the Houses of Parliament; its Cause and Remedy.*

Professor Tennant—*On the Colouring of Agates.*

Alphonse Gages—*On the Artificial Production of Anhydrite.*

Dr. Phipson—*On the Black Stones which fell from the Atmosphere at Birmingham.*

Frederick Field—*On a Specimen of Tin Ore, hitherto undescribed.*

Dr. Williamson—*On Isomorphism.*

P. Spence—*On Copper Smelting.*

Professor Wanklyn—*On the Rational Formula of Rosaniline.*

Professor Wanklyn—*On the Composition of Certain Organic Dyes.*

Tuesday, September 20, 1864.

The following papers were read before the Chemical Section :—

Professor Wanklyn—*On a Curious Example of Etherification.*

A. Vernon Harcourt—*On the Rate of Chemical Change.*

Professor Roscoe—*On a Chemical Photometer for Meteorological Observation.*

Professor Roscoe—*Contributions towards the Foundation of a Quantitative Photography.*

T. Fairley—*On the Action of Hydrogen upon Organic Polycyanides.*

Professor Rogers—*On Gas Tests.*

Dr. Paul—*On Useful Applications of Slag from Iron Smelting.*

Wednesday, September 21, 1864.

The following papers were read before the Chemical Section :—

Dr. G. Kemp—*Memorandum on Ozone.*

Wentworth Scott—*On Some Probable New Sources of Thallium.*

Professor W. B. Rogers—*To Exhibit the Inventions of Mr. Cornelius, of Philadelphia, for Lighting Gas Burners by Electricity.*

A. C. Kirk—*On the Production of Cold by the Expansion of Air.*

S. Mossman—*Some Observations on the Constitution of the Atmosphere.*

W. Gee—*Account of the Mode adopted at the Bradford Union for the Utilisation of Sewage.*

Dr. Paul—*On the Disposal of Town Refuse.*

Alfred Nobla—*On Reaumur's Porcelain.*

S. Highley—*Description of a Cheap Form of Automatic Regulator for the Electric Light.*

BRITISH PHARMACEUTICAL CONFERENCE.

President, H. Deane, *F.L.S.*

Bath, September 16.

We commence our notices of the proceedings of the Conference with an abstract of the Report of the Committee on "Accidental Poisoning," read by Mr. J. Raymond King at the third meeting.

After referring to the great interest which the subject of accidental poisoning had excited in the minds of members, the desirability of a thorough investigation of the question, with the object of preventing the recurrence of accidents, and the difficulties which beset the question, the report went on to state the course of proceeding adopted by the Committee in order to make the discussion of the subject interesting and practical. The Committee thought it advisable that their deductions and remarks should be based upon the results of statistical inquiry. They carefully examined the cases of accidental poisoning, as reported in the *Pharmaceutical Journal*, from July, 1862, to June, 1864, inclusive. These are twenty-five in number, and may be thus summarised :—Ten cases in which the mistake was committed by the administrator; two by a surgeon, one by a wholesale house, one by a grocer's wife, and eleven by retail chemists or their assistants. The cases were elaborately detailed in the report; and after a careful examination of the merits of each, and an intimation that the Committee had corresponded with many gentlemen likely to form an opinion on the subject, the Committee came to the following conclusions :—

1. That there are seventeen out of the twenty-five cases in which there is every reason to believe that a thoroughly effective poison-bottle would have prevented the accident.

2. That there are at least three cases in which, had the poison sold been folded in black paper, and labelled properly, the accident would not have occurred.

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[*] We have refrained from giving our own reports of these papers, as we hope to receive corrected copies of all the more important ones from the authors. They will appear under their proper headings in subsequent numbers of the Chemical News.

3. That 80 per cent. of the usual cases of accidental poisoning may be prevented by the use of proper precautions.

4. That only one of the twenty-five cases was the direct result of ignorance.

The practical suggestions and recommendations made by the Committee may be thus summarised :—

1. That to every one engaged in the practice of pharmacy, the facilities which exist for acquiring a theoretical as well as a practical knowledge of their business, renders it incumbent upon them to do all in their power to make themselves thoroughly acquainted with their profession, in order to future safety and usefulness.

2. That a separate and suitable part of their shops or premises be set apart for dispensing prescriptions wherever this has not already been done.

3. That in the dispensing department there be a repositorium toxicorum, or poison cupboard, with lock and key, in which should be kept all the concentrated and virulent poisons; or a small bottle of each sufficient for present use, the bottles being filled from store bottles, which should be kept in another and larger store cupboard or room, as required.

4. That the labels upon all shop and store bottles be in future so placed that the whole of the label can be seen at a glance, on the plan introduced by Messrs. Ford and Shapland, of London, instead of writing round the bottles, as at present arranged.

5. That wherever practicable, every prescription be checked by a second person before it is sent out.

6. That liniments, lotions, and all poisonous liquids be dispensed in bottles registered by Mr. Merrikin, of Bath, and called "Merrikin's Caution Bottles," as being in the opinion of the Committee superior to any other bottle hitherto used for the purpose, and that the labels be printed in red ink.

7. That the more concentrated and potent poisons, such as strychnine, morphia, prussic acid, &c., should not be sold in an unmixed state, without a medical order, under any circumstances whatever.

8. That no poison be sold in a dangerous quantity by any assistant or apprentice without the express sanction of the principal.

9. That every poison, in addition to its name, be distinctly marked "Poison" before it is sent out, excepting medicines dispensed from a prescription where the statement of the dose or use of it may be considered sufficient.

10. That dry poisons, such as oxalic acid, sugar of lead, red and white precipitate, &c., be invariably folded in *black* paper; and in addition to the name of the article, that a label with the word "Poison," in bold white letters on a black ground be securely attached to each packet.

The report was thoroughly practical, and was well received by the members of the Conference. It concluded by a forcible appeal to all in any way connected with the practice of pharmacy to advance themselves in scientific as well as practical knowledge, to discourage as much as possible the long hours of business to which both employers and employés are subject, thus weakening the power of concentration of mind on business matters, and rendering them irksome and distasteful, the consequence of which might possibly be serious both to themselves and the public. The committee thankfully acknowledged the assistance rendered by correspondents from various parts of the kingdom, and especially to the local secretary of the Conference, Mr. J. C. Pooley, of Bath, for the aid rendered to them in preparing and completing the report.

A long and important discussion then ensued. In the course of it a communication from Mr. Halliday was read, proposing a plan of raising a fund from which to indemnify chemists and druggists who, like Messrs. Clay and Ahrahams, in the late Liverpool case, might be compelled, under Lord Campbell's Act, to pay heavy damages to the family of a person who had died from poison through pure misadventure, and admittedly not from any fault of the chemist and druggist. This proposition was, however, very generally negatived by the meeting. The existence of such a fund would lay them open to inevitable prosecution, whereas now a man would not be proceeded against unless he were known to be possessed of a few spare thousands, which was not the case with very many chemists and druggists. Many other objections were expressed. The general feeling was that the law should be altered, not met.

The following papers were read at other meetings of the Conference, of most of which we shall give reports :—

C. R. Tichborne, F.C.S.—*On the Extraction and Preservation of Aromata.*

Mr. C. Umney—*On Commercial Carbonate of Bismuth.*

Mr. F. Baden Beuger—*On the Pharmaceutical Applications of Glycerine.*

J. Attfield, Ph.D., F.C.S.—*On the Application of Dialysis in determining the Crystalline Constituents of Plants.*

Mr. F. C. Clayton—*On Foreign Iodide of Potassium.*

Mr. John Tuck—*On a Test for Methylic Alcohol when Mixed with Ethylic Alcohol; with Remarks on Methylated Spirit.*

Mr. S. B. Proctor—*Report on the Weights and Measures used in Pharmacy.*

Henry Deane, F.L.S., and Henry B. Brady, F.L.S, F.C.S.—*On the Application of Microscopic Analysis to Pharmacy.*

Mr. James Spearing—*On Commercial Podophyllin.*

Mr. W. Walter Stoddart—*On the Purity of the Sulphate of Quinine of Commerce.*

D. Hanbury, F.L.S.—*A Chemist's Holiday—Jottings in France.*

T. B. Groves, F.C.S.—*On the Rancidity of Fats.*

Mr. W. D. Savage—*On the Processes for Preparing some of the Tinctures of the Pharmacopœias.*

Mr. J. T. P. B. Warren—*On the Cultivation of Medicinal Plants at Mitcham.*

Mr. T. Grundy.—*On the Preparation of Small Quantities of Concentrated Infusions.*

Mr J. Adams—*On Potentilla Tormentilla, Linn.*

J. B. Edwards, Ph.D., F.C.S.—*On the Old Calabar Bean.*

Mr. W. E. Heatbfield—*On the Morphia Salts of Commerce.*

R. Parkinson, Ph.D.—*On Commercial Phosphoric Acid.*

T. B. Groves, F.C.S.—*On the Assay of the Alkaloids in Medicinal Extracts.*

H. N. Draper, F.C.S.—*On an Improved Wine of Iron.*

F. Sutton, F.C.S.—*On Commercial Wine of Iron, with Suggestions.*

Mr. F. M. Rimmington—*On the Powders of Opium, Ipecacuanha, and Jalap, as met with in Commerce.*

Mr. J. C. Braithwaite—*On the amount of Alkaloid in Commercial Citrate of Iron and Quinine.*

Mr. A. F. Haselden—*Note on Cusparine.*

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, June 10, 1864.

"*On a Magnetic Experiment*," *by* John Tyndall, *Esq., F.R.C.S., M.R.I., Professor of Natural Philosophy, Royal Institution.*

There are two words which are very often employed in scientific writings—matter and force. The definition of each involves the conception of the other. We know nothing of force save through its operations upon matter, and we know nothing of matter save through the manifestations of its force. The characteristics of any force must be sought in the material changes which it is competent to produce. Some years ago I felt a great interest in the subject of magnetism, and in those years I devised an apparatus to enable me to investigate certain mechanical effects which accompany the act of magnetisation. I wished to apply this apparatus to diamagnetic bodies as well as paramagnetic ones—to bodies such as bismuth, as well as to bodies such as iron. I intend this evening to show you the action of this instrument, and to give, if I can, some explanation of the experiments of others which have been confirmed by my own.

Let us pass quickly in review the excitation of this wonderful power of magnetism. Here is a strong horseshoe magnet set upright, and here is a bent bar of steel, whose arms are the same distance apart as those of the horseshoe magnet. I draw the bent steel bar over the ends, or the poles, as they are called, of the magnet. It suddenly obtains the power of attracting this iron keeper and holding it fast. I reverse the stroke of the steel bar: its virtue has now disappeared; it is no longer competent to attract the keeper. I continue the stroke of the steel bar in the last direction, and now it is again competent to attract the iron: thus I can at will magnetise and demagnetise this bent piece of steel.

Here is a fine permanent magnet constructed by Logeman, of Haarlem, and competent to carry a great weight. Here, for example, is a dish of iron nails, which it is able to empty. At the other side of the table you observe another mass of metal bent like the Logeman magnet, but not, like it, naked. This mass, moreover, is not steel, but iron, and it is surrounded by coils of copper wire. It is intended to illustrate the excitement of magnetism by electricity. At the present moment this huge bent bar is so inert as to be incapable of carrying a single grain of iron. I now send an electric current through the coils that surround it, and its power far transcends that of the steel magnet on the other side. It can carry fifty times the weight. It holds a 56 lb. weight attached to each of its poles, and it empties this large tray of iron nails when they are brought sufficiently near it. I interrupt the current: the power vanishes, and the nails fall.

Now, the magnetised iron cannot be in all respects the same as the unmagnetised iron. Some change must take place among the molecules of the iron bar at the moment of magnetisation. And one curious action which accompanies the act of magnetisation I will now try to make sensible to you. Other men laboured, and we are here entering into their labours: the effect I wish to make manifest was discovered by Mr. Joule,* and was subsequently examined by MM. De la Rive, Wertheim, Marian, Matteucci, and Wartmann. It is this:—At the moment when the current passes through the coil surrounding the electro-magnet, a clink is heard emanating from the body of the iron, and at the moment the current ceases a clink is also heard. In fact, the acts of magnetisation and demagnetisation so stir the atoms of the magnetised body that they, in their turn, can stir the air and send sonorous impulses to our auditory nerves.

I have said that the sounds occur at the moment of magnetisation, and at the moment when magnetisation ceases; hence, if I can devise a means of making and breaking in quick succession the circuit through which the current flows, I can obtain an equally quick succession of sounds. I do this by means of a contact-breaker which belongs to a Ruhmkorff's induction coil. Here is a monochord, and a thin bar of iron stretches from one of its bridges to the other. This bar is placed in a glass tube, which is surrounded by copper wire. I place the contact breaker in a distant room, so that you cannot hear its noise. The current is now active, and every individual in this large assembly hears something between a dry crackle and a musical sound issuing from the bar in consequence of its successive magnetisation and demagnetisation.

Hitherto we have occupied ourselves with the iron which has been acted upon by the current. Let us now devote a moment's time to the examination of the current itself. Here is a naked copper wire which is quite inert, possessing no power to attract these iron filings. I send a voltaic current through it; it immediately grapples with the filings, and holds them round it in a thick envelope. I interrupt the current, and the filings fall. Here is a compact coil of copper wire which is overspun with cotton to prevent contact between the convolutions. At present the coil is inert; but now I send a current through it: a power of attraction is instantly developed, and you see that it is competent to empty this plate of iron nails.

Thus we have magnetic action exhibited by a body which does not contain a particle of the so-called magnetic metals. The copper wine is made magnetic by the electric current. Indeed, by means of a copper wire through which a current flows, we may obtain all the effects of magnetism. I have here a long coil, so suspended as to be capable of free motion in a horizontal direction: it can move all round in a circle like an ordinary magnetic needle. At its ends I have placed two spirals of platinum wire which the current will raise to brilliant incandescence. They are glowing now, and the suspended coil behaves in all respects like a magnetic needle. Its two ends show opposite polarities; it can be attracted and repelled by a magnet, or by a current flowing through another coil; and it is so sensitive that the action of the earth itself is capable of setting it north and south.

There is an irresistible tendency to unity in the human mind; and, in accordance with our mental constitution, we desire to reduce phenomena which are so much alike to a common cause. Hence the conception of the celebrated Ampère that a magnet is simply an assemblage of electric currents. Round the atoms of a magnet Ampère supposed minute currents to circulate incessantly in parallel planes; round the atoms of common iron he also supposed them to circulate, but in all directions—thus neutralising each other. The act of magnetisation has supposed to consist in the rendering of the molecular currents parallel to a common plane, as they are supposed to be in a permanent magnet.

This is the celebrated theory of molecular currents propounded by Ampère. You observe it consists in the application of conceptions obtained from sensible masses of matter to insensible or atomic masses. Let us follow out this conception to what would appear its legitimate consequences. I have said that we obtain both attractions and repulsions from electric currents: all these effects are deduced from one law, which is, that electric currents flowing in the same direction attract each other, while, when they flow in opposite directions they repel each other. Let me illustrate this law rapidly. Here are two flat coils suspended facing each other, and about eight inches apart. I send a current through both, causing it to flow through them in the same direction; the coils instantly clash and cling together in virtue of their mutual attraction. I now reverse the current through one of them, and they fly a yard asunder, in virtue of their mutual repulsion. And now one of them twists its suspending wire so as to turn its opposite face to the other coil; the currents are now again in the same direction, and the coils clash and cling as in the first instance. Imagine, then, our molecular currents flowing round the atoms of this iron bar in planes perpendicular to the length of the bar. From the law just enunciated we should infer the mutual attraction of those currents; and from this attraction we should be disposed to infer the shortening of the bar at the moment of magnetisation. Here, for example, is a coil of copper wire suspended vertically; the end of the coil dips into this little basin of mercury. From a small voltaic battery behind I send a current through the coil; and because it passes in the same direction through all its convolutions, they attract each other. The coil is thereby shortened;

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* The sound, I find, was first noticed by Mr. Page.—J. T., June 16.

its end quits the mercury with a spark; the current ceases; the wire falls by its own gravity; the current again passes, and the wire shortens as before. Thus you have this quick succession of brilliant[*] sparks produced by the shortening of the wire and the interruption of the current as it quits the mercury.

Is it a fact, then, that an iron bar is shortened by the act of magnetisation? It is not. And here, as before, we enter into the labours of other men.

Mr. Joule was the first to prove that the bar is lengthened. Mr. Joule rendered this lengthening visible by means of a system of levers and a microscope, through which a single observer saw the action. The experiment has never, I believe, been made before a public audience; but the instrument referred to[†] at the commencement of this lecture will, I think, enable me to render this effect of magnetisation visible to everybody present.

Before you is an upright iron bar, two feet long, firmly screwed into a solid block of wood. Sliding on two upright brass pillars is a portion of the instrument which you see above the iron bar. The essential parts of this section of the apparatus are, first, a vertical rod of brass, which moves freely and accurately in a long brass collar. The lower end of the brass rod rests upon the upper flat surface of the iron bar. To the top of the brass rod is attached a point of steel; and this point now presses against a plate of agate, near a pivot which forms the fulcrum of a lever. The distant end of the lever is connected, by a very fine wire, with an axis on which is fixed a small circular mirror. If the steel point be pushed up against the agate plate, the end of the lever is raised; the axis is thereby caused to turn, and the mirror rotates. I now cast a beam from an electric lamp upon this mirror; it is reflected in a luminous sheaf, fifteen or sixteen feet long, and it strikes our screen, there forming a circular patch of brilliant light. This beam is to be our index; it will move as the mirror moves, only with twice its angular velocity; and the motion of the patch of light will inform us of the lengthening and shortening of the iron bar.

I employ one battery simply to ignite the lamp. I have here a second battery to magnetise the iron bar. At present no current is passing. I make the circuit, and the bright image on the screen is suddenly displaced. It sinks a foot. I break the circuit: the bar instantly shrinks to its normal length, and the image returns to its first position. I make the experiment several times in succession: the result is always the same. Always when I magnetise, the image instantly descends, which declares the lengthening of the bar; always when I interrupt the current, the image immediately rises. A little warm water projected against the bar causes the image to descend gradually. This, I believe, is the first time that this action of magnetism has been seen by a public audience.

I have employed the same apparatus in the examination of bismuth bars; and, though considerable power has been applied, I have hitherto failed to produce any sensible effect. It was at least conceivable that complementary effects might be here exhibited, and a new antithesis thus established between magnetism and diamagnetism.

No explanation of this action has, to my knowledge, been offered; and I would now beg to propose one which seems to be sufficient. I place this large flat magnet upon the table; over it I put a paper screen; and on the screen I shake iron filings. You know the beautiful lines in which those filings arrange themselves—lines which have become classical from the use made of them in this Institution; for they have been guiding-threads for Faraday's intelligence while exploring the most profound and intricate phenomena of magnetism. These lines indicate the direction in which a small magnetic needle sets itself when placed on any of them. The needle will always be a tangent to the magnetic curve. A little rod of iron, freely suspended, behaves exactly like the needle, and sets its longest dimension in the direction of the magnetic curve. In fact, the particles of iron filings themselves are virtually so many little rods of iron, which, when they are released from the friction of the screen by tapping, set their longest dimensions along the lines of force. Now, in this bar magnet the lines of force run along the magnet itself, and, were its particles capable of free motion, they also would set their longest dimensions parallel to the lines of force—that is to say, parallel to the length of the magnet. This, then, is the explanation which I would offer of the lengthening of the bar. The bar is composed of irregular crystalline granules; and, when magnetised, these granules tend to set their longest dimensions parallel to the axis of the bar. They succeed, partially, and produce a microscopic lengthening of the bar, which, suitably magnified, has been rendered visible to you.[‡]

Perhaps you do not see the magnetic curves from your present position, but I will enable you to see them. I have here an electric lamp turned on its back, and from it a vertical cylinder of light now issues. Over the aperture of the lamp I place two small bar magnets, enclosed between two plates of glass. The vertical beam is received upon a looking-glass which reflects it on to the screen. In the path of this reflected beam I place a lens, and thus obtain upon the screen a magnified image of the two small bar magnets. And now I sprinkle this fine iron sand on the plate of glass, and you see how it arranges itself under the operation of the magnets. A most beautiful display of the magnetic curves is now before you. And you observe when I tap the glass how the particles attach themselves by their ends, and how the curves close in upon each other. They try to attach themselves thus and close thus up in the solid iron bar: the consequence is that the longitudinal expansion is exactly counterbalanced by the transverse contraction, so that the volume of the bar remains unchanged.

But can we not bring a body with moveable particles within an electro-magnetic coil? We can; and I will now, in conclusion, show you an experiment devised by Mr. Grove, which bears directly upon this question, but the sight of which, I believe, has hitherto been confined to Mr. Grove himself. At all events, I am not aware of its ever having been made before a large audience. I have here a cylinder with glass ends, and it contains a muddy liquid. This muddiness is produced by the magnetic oxide of iron which is suspended mechanically in water. Round the glass cylinder I have coiled five or six layers of covered copper wire; and here is a battery from which a current can be sent through the coil. First of all, I place the glass cylinder in the path of the beam from our electric lamp, and, by means of a lens, cast a magnified image of the end of the cylinder on the screen. That image at present possesses but feeble illumination. The light is almost extinguished by the suspended particles of magnetic oxide. But, if what I have stated regarding the lines of force through the bar of magnetised iron be correct, the particles of the oxide will suddenly set their longest dimensions parallel to the axis of the cylinder, and also in part set themselves end to end when the current is sent round them. More light will be thus enabled to pass; and now you observe the effect. The moment I establish the circuit the disc upon the screen becomes luminous: I interrupt the current, and gloom supervenes; I re-establish it, and we have a luminous disc once more.

The apparatus, as I have stated, was really invented to examine whether any mechanical effect of this kind could be detected in diamagnetic bodies; but hitherto without result. And this leads me to remark on the large ratio which the failures of an original inquirer bear to his successes. The public see the success—the failure is known to the inquirer alone. The encouragement of his fellow-men, it is true, often cheers the investigator and strengthens his heart; but his main trials occur when there is no one near to cheer him, and when, if he works aright, he must work for duty and not for reputation. And this is the spirit in which work has been executed in this Institution, by a man who has, throughout his life, turned a deaf ear to such allurements as this age places within the reach of scientific renown; and it behoves every friend of this Institution to join in the wish that that man's spirit may continue to live within its walls, and that those who come after him may not shrink from his self-denial while endeavouring to merit a portion of his fame.

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[*] Rendered brilliant by the introduction of a coil of wire and a core of soft iron into the circuit.

[†] Very skilfully constructed by Mr. Becker.

[‡] My assistant, Mr. Barrett, has just drawn my attention to a paper by M. De la Rive in which this explanation is given. To him, therefore, belongs the entire credit of it.—J. T., June 16.

ACADEMY OF SCIENCES.

September 12.

The first paper read was of great interest, though not chemical. It was by the astronomer, M. Faye, "*On Errors in Observation which have a Physiological Origin*," and showed that two senses in operation together never act simultaneously. The eye acting alone will measure the most minute distances; the ear can distinctly appreciate the hundredth of a second; and the touch will recognise vibrations at the rate of 500 to a second. But no two astronomers watching the passage of a star and counting the beats of a pendulum will agree as to the precise moment of time at which the star passes the meridian. Means, however, have been found to obviate these errors, inseparable from human observations and increased by indigestions, fatigue, and numerous other causes, so far as the sun is concerned, by photography and the electric telegraph; and the author hopes that it will be found possible to employ the same agents in observations on the stars.

M. de Luca contributed a paper entitled "*Chemical Researches on the Spontaneous Decomposition of Pyroxiline.*" The author points out that the decomposition is greatly accelerated by the action of direct sunlight or artificial heat. Among the products of the slow decomposition he found glucose, gummy matters, oxalic acid, a small amount of formic acid, and what he believes to be a new acid, of which he intends to give a further account. The glucose amounted to 14 per cent. of the original weight of guncotton. The products of spontaneous decomposition in vacuo seem to be the same as in air.

M. Bechamp presented a note giving a further account of his soluble ferment *zymase*, which we noticed in a recent number. He finds an analogous substance in flowers, which he therefore names *anthozymase*, and also in the juice of fruits, *morozymase*. These ferments have the power of converting cane sugar—which, according to M. Bechamp, is no sugar—into real sugar, glucose. They do not act on glucosides, at least they do not split up salicine, nor do they transform starch. They are therefore specific ferments. The two latter are precipitated from the pressed juices of fruits and flowers by alcohol.

In a note on the "*Solubility of Salts*," M. Alluard describes a stove for keeping solutions at a constant temperature, which does not seem to possess any particular advantage.

CORRESPONDENCE.

Continental Science.

Paris, September 21.

M. Duporteuil, one of the engineers of the *Chemin de fer de l'Ouest*, has lately been applying the hydraulic press to welding large pieces of wrought iron. The steady compression exercised by the hydraulic press is stated to have great advantages over the intermittent blows of the steam hammer.

Your contemporary *Galignani* is so famous for flying scientific *canards*, that I give you the following somewhat reluctantly:—M. Corbelli has discovered a means of producing aluminium in large quantities directly from clay, without the use of sodium. The clay is first cleansed from stones, bits of wood, and other accidental impurities, and then dried. One hundred grammes are then washed in nitric, sulphuric, or hydrochloric acid, to remove the iron with which it is generally contaminated. The purified clay is then dried and heated in a crucible to 450° or 500° C. Two hundred grammes of prussiate of potash and 150 grammes of common salt are then thrown in, and the whole is then heated to whiteness. In the cold crucible a button of aluminium will be found.

The German scientific journals mention a singular case of poisoning by anilic compounds. A young man, whose daily duty it was to pack aniline powder colours, and who, consequently, took large quantities of the dust into his lungs, although he took the precaution of using a pocket handkerchief as a respirator, found himself attacked with a severe cough, accompanied by anomalous symptoms, such as great weakness, and constant fainting fits, dilatation of the pupils, pains in the head, and convulsions of the muscles of the face and of the extremities. The symptoms, however, passed away in time, and the young man recovered with no further bad effects than the total loss of his hair.

The twenty-fifth anniversary of the foundation of the Observatory of Pulkowa was celebrated on the 19th ult. The Central Hall of the Observatory was crowded with astronomers from all parts, anxious to do honour to the veteran philosopher, M. W. Struve, the founder of this celebrated Observatory. The visitors were received by the venerable *savant* and his talented son, M. Otto Struve, acting director of the Observatory, surrounded by the whole of the scientific staff. Addresses were given by both father and son, in which they expressed their hope that the cordial co-operation which at present exists between astronomers of all nations would be continued. M. Otto Struve referred especially to the great good effected by the zeal shown by the members of the Royal Astronomical Society of London, and spoke of the advantages that had resulted from the intimate alliance existing between the two great centres of astronomical science, Greenwich and Pulkowa. Mr. Warren de la Rue, President of the Royal Astronomical Society, represented Great Britain; Professor Henner, of Gothe; M. Claussen, of Dorpat; Dr. Bruhns, of Leipzig; Dr. Förster, of Berlin; Dr. Schönfeld, of Mannheim, and several other astronomers of eminence were present, to the number of one hundred. Singularly enough, France was unrepresented.

In the *Moniteur* a few days since there appeared a report to the Emperor emanating from the pen of M. Duruy, the indefatigable Minister of Public Instruction, giving the names of those who, besides M. Rhumkorff (who, as I have before informed you, gained the 50,000 francs prize) have done the state some service in the application of voltaic electricity to useful purposes, and who are adjudged honourable mention. They are M. Lenoir, for his gas engine; M. Caselli, for his telegraphic apparatus; M. Gaiffe, for his method of engraving by electricity; M. Bonelli, for his electric loom; Mr. Hughes, for his electro-printer; M. Froment, for his electro-motion engines; MM. Foucault and Serrin, for their electric lamp, and one or two more of less note. M. Froment is recommended for the officers' cross of the Legion of Honour. The same prize will be adjudged for the same purpose in 1868, when I hope to see a few more Englishmen in the list.

A go-ahead Yankee firm having offered a prize of 1000 dollars in the *New York Tribune* to the inventor of an artificial substance having the properties of ivory, to replace that substance for billiard-balls, a M. Dupré has produced a material from paper pulp, sulphate of baryta, and gelatine, which, according to two of our crack billiard players here, is quite equal to ivory in every respect for this particular purpose.

From artificial ivory to artificial butter there is only one step. Here is the receipt for it:—Half a kilogramme of mutton fat, melted in about 270 grammes of fresh milk. When fully dissolved, and while still warm, filter through muslin and add 625 grammes of *poppy oil*, stirring the while. Put the whole once more over the fire and add 60 grammes of *crust of bread* (!), 15 grammes of *tarragon* (!!), and—Heaven help us—*two onions cut fine* (!!!), after which strain again. The inventor states that the mixture has enormous advantages over the real article, and that pastry made with it is particularly light, and of a most appetising flavour. In these days of advanced science one really must be careful with whom one breakfasts, for fear of being made a *corpus vile*. I refrain from giving you the name either of the inventor of this notable compound or that of the scientific journal in which the receipt appears.

Dr. Barth, in the *Réforme Agricole*, recommends benzol as a perfect cure for any parasitical affection, such as itch, *pediculi* in the human subject, ticks in cattle, &c. It has long been a remedy in England for curing dogs of fleas.

I fear that French scientific writers never look at the current scientific literature of other countries, or an esteemed writer in *Cosmos* would not have only just found that Dr. *Danglish* had invented a method of making bread without yeast.

Discovery of Diolysis.

To the Editor of the Chemical News.

Sir,—The following is the translation of a letter from Mr. Graham, which appeared in the last weekly number of the *Mondes*, in reply to a communication on the subject of M. Dubrunfaut's alleged anticipation of the discovery of dialysis, which was published in the number of that journal for August 11. We have reason to believe that Mr. Graham's letter was duly forwarded on August 15, although not published till three weeks afterwards:—

"As a constant reader of the *Mondes*, I could not fail to observe the account given in a recent number of that journal of a new process invented by M. Dubrunfaut, and patented on June 22, 1863, to extract sugar from molasses by dialysis. I have little doubt that by dialysis through parchment paper M. Dubrunfaut might succeed in separating gum and a portion of the colouring matter from molasses; but the earlier process of the same chemist, patented on April 1, 1854, appears to be different in principle, and intended to effect a separation of crystalline salts, but not gum and colloid colouring matters, from sugar—an effect which, as you justly observe, is not dialysis. For neither animal membrane nor parchment paper has any effect in separating different crystalline substances from one another. All such bodies, when in solution, pass through membrane with the same facility. The separation of salts from sugar which was observed by M. Dubrunfaut could only be very partial, and I may be allowed to say that it is simply the effect of the greater rapidity of diffusion in water possessed by the potash salts than by the crystalline sugar contained in the molasses. In fact, as is directly proved in my memoir of 1854, that the interposed membrane goes for nothing in the phenomenon. A great number of separations by diffusion of artificial and natural mixtures of salts (as, for instance, sea-water) are described in my memoir on the diffusion of liquids, which is printed in the *Annales de Chemie et de Physique* for May, 1850 (t. 29, p. 197)."

It is to be observed of Dubrunfaut's first patent of April 1, 1854, that it does not effect a dialysis, but the separation (very partial) of crystalloids by diffusion, which had been previously exemplified in great detail in Mr. Graham's original paper on "Liquid Diffusion," published in the *Philosophical Transactions* of 1850, or four years before. Again, the second patent of M. Dubrunfaut, dated June 22, 1863, is manifestly founded on Mr. Graham's paper on dialysis published a year earlier, in 1862, from which the use of parchment paper has been borrowed by the patentee. I am, &c. S. S.

Numerical Relations of Equivalents.

To the Editor of the Chemical News.

Sir,—Mr. Noble, in his eloquent and elaborately studied reply to "Studiosus," has endeavoured to "kill two birds with one stone;" for after disposing of the law of "Studiosus" in a very summary and thoroughly original manner, he proceeds to fall foul of Mr. Newland, stigmatising the relations which the latter has pointed out as "a great deal of nonsense, and in many cases mere rubbish"—terms, to say the least, not over complimentary.

Regarding the "approximations and allowances" which Mr. Noble so strongly condemns, I find that they are largely made use of, not only by the parties whom he takes to task, but also by Dumas, Gregory, Mercer, and others, who have written upon this subject. For instance, in Abel and Bloxam's Handbook (second edition, p. 525) the difference between the equivalents of rhodium and palladium amounting to 1·1, or using Williamson's equivalents to 2·5, is described as "very slight, and probably due to mere errors of analysis."

Surely the authority of Professor Abel upon such a matter will not be questioned—at all events, not in Woolwich Arsenal.

Mr. Noble is of opinion "that it is much easier to find laws for the equivalent numbers than to verify the equivalents experimentally; but really the two things have no more connection than "chalk and cheese." For my own part, if any comparison be advisable, I could mention a hundred chemists who either have verified, or are fully capable of verifying, an ordinary equivalent; but I do not know a single chemist who can thoroughly exhibit all the relations among the atomic weights, still less one who can explain why and wherefore such relations exist.

I am, &c., Inquirer.

London, September 6.

MISCELLANEOUS.

British Association.—The next meeting of the Association will be held at Birmingham under the presidency of Professor Phillips.

ANSWERS TO CORRESPONDENTS.

⁎ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

In order to give early reports of the proceedings of the British Association and the Pharmaceutical Conference, we are compelled to defer for a time the publication of several interesting papers, and our usual "Notices of Books."

Dr. Adriani's lengthy reply to Dr. Schwarz must be deferred for the present.

W. B.—Not available for aniline, but their presence is not objectionable.

P. C.—Nitrate of potash and charcoal, tipped with the usual phosphorous composition. For the scented fusees, the pastille composition may be used.

Chemical.—Several patents and new processes are noticed in various numbers of the Chemical News, but no details for guiding manufacturers. You will find an account of the ordinary process in Knapp and Richardson's "Technology." No letter received before.

Salicine.—1. We do not remember that it has been done. 2. Ettling's process by heating benzoate of copper is, perhaps, the easiest.

Reader.—Yes, in tolerably strong solutions.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Rational Formula of Rosaniline,[*]

by J. ALFRED WANKLYN.

ACCORDING to Hofmann, the empirical formula for anhydrous rosaniline is $C_{20}H_{19}N_3$; the salts being $C_{20}H_{19}N_3,XH$ and $C_{20}H_{19}N_3,3XH$, whilst the base on being liberated from one of its salts takes the form $C_{20}H_{19}N_3,H_2O$.

It will be apparent that anhydrous rosaniline is just equal to a base consisting of two atoms of tolyl and one of phenyl along with three atoms of nitrogen.

$$C_{20}H_{19}N_3 = N_3\left\{\begin{matrix}C_7H_7\\C_7H_7\\C_6H_5\end{matrix}\right.$$

This manner of constructing the formula of rosaniline, which appears to be adopted by some chemists, derives a remarkable confirmation from the circumstance discovered by Hofmann, that it is requisite to employ a mixture of toluidine and aniline in the manufacture of rosaniline, neither toluidine nor aniline alone being capable of yielding the dye.

Notwithstanding this capital fact, it is quite certain that rosaniline is not

$$N_3\left\{\begin{matrix}C_7H_7\\C_7H_7\\C_6H_5.\end{matrix}\right.$$

In several reactions rosaniline displays three atoms of easily replaceable hydrogen.

Thus in the famous process for producing aniline blue three atoms of phenyl are changed against three atoms of hydrogen.

$$C_{20}H_{19}N_3 + 3C_6H_5H_2N = C_{20}H_{16}(3C_6H_5)N_3 + 3H_3N.\dagger$$

Hofmann's beautiful research relating to this transformation of aniline red into aniline blue leaves no doubt that three atoms of hydrogen are concerned.

Again the iodides of the alcohol radicals react upon rosaniline, producing ethylated bases. Hofmann has not yet published his research on "Ethyl-rosaniline," but judging from the quantity of iodide of ethyl actually destroyed in the operation, there can be little doubt that substitution goes on to the length of three atoms.

In order to judge whether this action upon the "hydrogen atoms" in rosaniline must be looked upon as a very close representation of the action upon the hydrogen atoms in common ammonia, I have inquired whether Carey Lea's method was applicable to rosaniline.

Carey Lea, as is well known, has shown that nitrate of ethyl occupies a place among the very few ethers capable of forming ethylated ammonias by reaction upon ammonia. I have recently succeeded in obtaining ethylated rosaniline by the action of nitrate of ethyl upon rosaniline.

From all this it results that the rational formula of rosaniline must display three atoms of hydrogen in association with nitrogen.

A consideration of the entire case leads me to propose the following formula:—

$$C_2\left\{\begin{matrix}NHC_6H_5\\NHC_6H_5\\NHC_6H_5\\H\end{matrix}\right. \qquad \overset{\text{Type.}}{C_2\left\{\begin{matrix}H\\H\\H\\H\end{matrix}\right.}$$

I here write rosaniline on the "ethylene" type, replacing three atoms of typical hydrogen by three atoms of phenylamid.

Just as ethylene tends to take up the representatives of two atoms of hydrogen, and thereby passes into a body of the "hydride of ethyl" type, so rosaniline tends to take up two atoms of hydrogen, thereby becoming a representative of hydride of ethyl.

$$C_2\left\{\begin{matrix}H\\H\\H\\H\end{matrix}\right. + H_2 = C_2\left\{\begin{matrix}H\\H\\H\\H\\H\\H\end{matrix}\right.$$

$$\overset{\text{Rosaniline.}}{C_2\left\{\begin{matrix}NHC_6H_5\\NHC_6H_5\\NHC_6H_5\\H\end{matrix}\right.} + H_2 = \overset{\text{Leucaniline.}}{C_2\left\{\begin{matrix}NHC_6H_5\\NHC_6H_5\\NHC_6H_5\\H\\H\\H\end{matrix}\right.}$$

The three atoms of hydrogen in union with the three atoms of nitrogen are, of course, easily replaceable.

The fourth atom of hydrogen being in direct association with carbon is not easily replaceable.

The power that nitrogen has of being either three or five atomic is, of course, the explanation of the mono-acid and tri-acid salts. There should be likewise bi-acid salts.

Quite in accordance with the formula is the fact that distillation with potash gives much aniline and a residue of carbon.

$$C_2\left\{\begin{matrix}NHC_6H_5\\NHC_6H_5\\NHC_6H_5\\H\end{matrix}\right. + H_2O = C_2\left\{\begin{matrix}O''\\NHC_6H_5\\H\end{matrix}\right. + 2NC_6H_7$$

The group

$$C_2\left\{\begin{matrix}O''\\NHC_6H_5\\H\end{matrix}\right.$$

would, on maltreatment, be very likely to carbonise.

A reaction which may be predicted is this. Careful treatment with alkali may be expected to give aniline and glycollic acid.

Query.—Does not pure aniline, free from toluidine, give rosaniline on treatment with chloride of carbon?

London Institution.

Revision of the Mineral Phosphates, by A. H. CHURCH, *M.A. Oxon, Professor of Chemistry, Royal Agricultural College, Cirencester.*

(*Continued from page 146.*)

No. II.—DUFRENITE.

To dufrenite or green iron ore the formula

$$2Fe_2O_3,PO_5 + 2\tfrac{1}{2}HO$$

is assigned by Dana. Professor Odling, in the list of orthophosphates given on page 309 of his "Manual of Chemistry," writes this mineral $Ffe'''PO_4Ffe'''H_3O_3$, but has not, I believed, published, any experimental proofs of this formula. Having submitted a specimen of dufrenite from Bavaria to analysis, I can now confirm Professor Odling's view.

The water in this mineral is in part retained obstinately; if determined by the loss on *moderate* ignition, the percentage will prove too low. Another cause also will conduce to the same result—dufrenite occurs in radiating fibrous concretions upon an anhydrous matrix, generally hæmatite. Now, it is extremely difficult to prevent any admixture of the anhydrous mineral with the dufrenite taken for analysis; the dark silky crystals of the latter must be carefully examined by a hand magnifier to ascertain their perfect homogeneousness. The following results were obtained with a most carefully selected specimen of dufrenite, which was submitted in a state of fine powder to the drying action of sulphuric acid in vacuo:—

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[*] Read before the British Association Bath Meeting, and communicated by the Author.

[†] The first suggestion of the kind of change which takes place when aniline red becomes aniline blue was, I believe, due to me. In the winter 1862-63 I explained it by saying that aniline red lost hydrogen and gained phenyl; supporting my view by adducing the facts that the red gave more than its weight of blue while ammonia was evolved.

22·78 grains of dufrenite, after two days' drying as above, weighed 22·75 grains.

The mineral contains, therefore, no hygroscopic water; nor does the air-dried mineral alter in weight when kept in the water-oven.

The total amount of water contained in dufrenite is shown by the following numbers:—

22·75 grains gave 2·4 grains water.

This result corresponds to 10·55 per cent. H_2O. The formula $Fe_2PO_4 + Fe_2H_3O_3$ requires 10·46 per cent. H_2O. It is remarkable that the ferric hydrate presumed to exist in dufrenite (and delvauxite) should not be altered by a heat of 100° C., which changes the simple precipitated ferric hydrate $Fe_2H_3O_3$ into $Fe_4O_3 + 2H_2O$ $(=Fe_4H_4O_5)$, with the loss from 2 atoms of the hydrate of 1 atom of water. Although air-dried dufrenite has the same composition as delvauxite dried at 100°, yet the chrome-green colour of the former mineral is strikingly different from the red-brown tint of the latter. After ignition the minerals are also identical in composition, but the colours of the ignited residues are not alike—that of delvauxite having a violet or purple shade not seen in the orange-red residue of dufrenite.

Note on the Existence of Lithium, Strontium, and Copper in the Bath Waters, by Professor* ROSCOE, *F.R.S.*

AT the request of Sir Charles Lyell I undertook the examination of the residue obtained by the evaporation of the Bath waters (King's Bath spring) by spectrum analysis. About four ounces of the deposit from the basin in the pump-room was kindly forwarded to me by Dr. Falconer. This was first examined for strontium, barium, lithium, rubidium, and cæsium, by first boiling it out with water acidulated with hydrochloric acid; this separated the sulphate of calcium, of which the deposit mainly consists, together with most of the sulphates of strontium and barium which might be present. The residue was fused with carbonate of sodium, and the carbonates examined for barium and strontium, according to the method described by Bunsen. No trace of barium was found, but strontium was present in quantities sufficiently large to enable it to be easily detected. The portion of the deposit soluble in dilute hydrochloric acid was freed from alkaline earths by several precipitations with carbonate and oxalate of ammonia, and in this precipitate strontia was again detected. The magnesium was next separated by ignition of the mixed chlorides with oxide of mercury, and on examining the portions of the residue soluble in water, the red lithium line was plainly visible. The alkalies were precipitated as platinum double salts, but after long washing no other lines than those of potassium could be detected. It appeared, however, possible that the greater portion of the more soluble alkaline salts might not be spontaneously deposited from the water; I therefore requested Dr. Falconer to obtain some residue from the evaporation of the whole water, but on examining, according to the above method, the salts thus derived from twenty gallons of water, I was still unable to detect the smallest traces of either rubidium or cæsium. In the course of both analyses I detected the presence of copper in the deposit by the usual tests. I have to thank Mr. Charles Moore for his kindness in forwarding a number of samples of various deposits from the Bath springs, some of which I have examined, but without discovering any other substance whose presence was previously unknown in the Bath waters.

Researches on Sulphuretted Combinations of Uranium by M. ADOLPHE REMELE.

(Continued from page 124.)

Sulphuranylates of Potash and Soda.—In treating nitrate of uranium, dissolved in alcohol, by a solution of monosulphide of potassium or hydrosulphate of sulphide of sodium, precipitates of a beautiful orange colour are obtained, which may be washed in alcohol diluted with water. After undergoing washing for a sufficient length of time, they disengage with acids, a little sulphuretted hydrogen, but no free sulphur is separated, perhaps because there are not homogeneous products.

When the precipitation is effected with sulphide of sodium in an aqueous solution, the precipitate is after a longer or shorter time transformed into a grey-green matter. This it is impossible to filter, whether water or alcohol is used for the washing. In either case the colour becomes brownish yellow, and part of the matter traverses the pores of the paper.

Brown Sulphuranylate of Baryta.—This is the most alterable of all these bodies I have examined. For its preparation precipitate an alcoholic solution of nitrate of uranium by sulphide of barium dissolved in water, and wash with alcohol at 36°. The dark brown-red precipitate decomposes rapidly in the air, becoming brick red, and this decomposition takes place up to a certain point even when the precipitate is impregnated with a strong proportion of alcohol. Immediately after receiving it on the filter, place it under the receiver of an air pump, but even then a partial transformation is almost unavoidable.

Hydrochloric acid dissolves the brown matter with disengagement of sulphuretted hydrogen. Nevertheless a milkiness remains in the liquid, proceeding from a little free sulphur.

Green Sulphuranylate of Baryta.—By adding a soluble salt of baryta to the black solution of sulphide of uranyle in hydrosulphate of ammonia a dirty green precipitate is formed. To collect this it should be immediately thrown on a filter, and then washed on the filter with water as cold as possible, until the washings cease to colour a solution of acetate of lead, when it should be dried in a vacuum.

The substance obtained treated by hydrochloric acid disengages sulphuretted hydrogen with brisk effervescence; the acid solution is rendered milky by the separation of free sulphur. On heating the green body over a lamp in a tube closed at one end a very curious phenomenon of light is produced. At about 200° all the matter suddenly becomes incandescent.

Two analyses of this product gave me 14·5 per cent. of uranium, 49 per cent. of barium, and 14 per cent. of sulphur. These numbers lead me to conclude, at least approximatively, that there are six equivalents of sulphide of barium for one equivalent of sulphide of uranyle. The formula of the green compound, which also contains water, would then be $= [Ur_2O_2]\,S.6BaS + aq.$

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* Read at the British Association Bath meeting. Communicated by the author.

By washing the green precipitate in water, the temperature of which is very little above the ordinary point, the substance becomes transformed into a dirty yellow mass by abandoning sulphide of barium. It is then no longer possible to wash the green sulphuranylate by decanting, for whilst it remains in contact with a somewhat considerable quantity of water it is slowly transformed, provided access of air is limited, into brown sulphoranylate, and the liquid takes a strong green colour from the sulphide of barium. This remarkable fact proves that the brown-red compound contains less alkaline-earthy sulphide than green sulphide.

Uranium Red.—Sulphide of uranyle, after precipitation from a solution of nitrate of uranium in water, is transformed after twenty-four or forty-eight hours into a beautiful blood red matter, when the liquid in which the change is effected is exposed to the air. Several chemists have already observed this phenomenon; M. Rivot has observed the change of colour is effected more rapidly (in less than six hours) when the hydrosulphate has been used in a previous precipitation.

The red substance, which I propose to call uranium red, is relatively stable; it can be sufficiently well washed with pure water, and afterwards may be dried at about 100° without any apparent decomposition. By drying it contracts considerably, and becomes darker; after being pulverised it shows under the microscope octahedral crystals, or small cubes with the modications of the octahedral. These crystals, which are of a dark red colour, are disseminated in a light red mass; in thin layers, yellowish portions are, however, visible.

The analysis many times repeated of a product of this kind yields the following numbers—uranium, 71 per cent., sulphur, 4·5 per cent.; ammonia, 1·9 per cent.; water, about 10 per cent. These numbers lead to no rational formula. Ammonia is not indispensable to the existence of the red body, for it may be expelled by potash without affecting the colour.

It is easy to ascertain that uranium red cannot be a definite compound, but, on the contrary, that it is invariably a mixture. In collecting successively, at intervals of eight or twelve hours, the products obtained from one and the same liquid, the red colour becomes brighter and brighter. This is easily explained, as there always remains along with the red matter a certain quantity of sulphide of uranyle, which by washing is transformed more or less completely into hydrated sesquioxide of uranium. Analyses also of different products yield for the various elements results which often differ by several hundredths from one another.

What, then, is the colouring principle in uranium red? By heating it in a closed tube, or a tube open at one end, to 230 or 250°, an ammoniacal salt is sublimated which is hyposulphite of ammonia; the solution of this salt in water, treated at a gentle heat by sulphuric acid, disengages a very notable proportion of sulphurous acid, becoming at the same time milky, by the separation of free sulphur. Hence it would seem that hyposulphurous acid enters into the composition of uranium red; as to the uranium itself, the result of my experiments and analyses is, that it exists, in chief part at least, in the state of protoxide. It would then seem that uranium red is produced by hyposulphurous acid which forms in hydrosulphate of ammonia through the intervention of the air; and the essential matter may be a hyposulphite of protoxide of uranium. I submit this as a simple hypothesis,—it is not impossible we may have to do with a sub-sulphide of uranyle.

Uranium red is insoluble in water; but it generally remains partially suspended for an almost indefinite time, colouring the liquid light red. It possesses several characteristics of hyposulphites; a solution of nitrate of silver, for instance, blackens it immediately, and after a time the filtered liquid deposits yellow hyposulphite of silver. On the other hand, it evinces several reactions which perfectly distinguish it from ordinary hyposulphites. Thus, hydrochloric, nitric, and sulphuric acids, even when much diluted, dissolve it, disengaging only a little sulphuretted hydrogen, and separating the greater part of the sulphur under the form of yellowish flakes.*

An insufficient quantity of these same acids leaves a darker red residue. The same thing takes place when the substance is treated by a solution of carbonate or sulphite of ammonia, which decompose it equally well. The residue, less easily attackable by these various reagents, appears in the form of small octahedral crystals, which on trituration resume the colour of the original matter; it contains besides free sulphur.

In the present state of knowledge on the subject, the following is all I can say on the nature of uranium red :—

So long as it remains in the state of hydrosulphate of ammonia it is a mixture of a red crystalline body, the composition of which is still doubtful, with sulphide of uranyle†. After washing it becomes a mixture of the same red body with hydrated sesquioxide of uranium and a small quantity of sulphate of uranyle.

In each case there is a little hyposulphite of ammonia, but it has been hitherto found impossible to ascertain whether this salt exists in combination or not.

Direct Preparation of Uranium Red.—By all imaginable means I have endeavoured to produce the colouring matter of uranium red in a pure state, first with hyposulphite of ammonia and soda on almost neutral solutions of sesquioxide and protoxide of uranium, but without producing a substance analogous to the red product; on the contrary, hyposulphites do not even give precipitates with salts of uranium.

A very singular observation at length led me in a more satisfactory direction. By treating nitrate of uranium by a solution of sulphite of ammonia, mixed with hydrosulphate of ammonia, there is formed when the proportions of the two reagents bear a certain proportion to each other, a precipitate variable in colour, which contains in a mixed state a certain quantity of a light red mass. After numerous experiments made in consequence of this phenomenon, I succeeded in preparing uranium red by direct processes. The following is the most successful method :—

As the point of departure I take a beautiful yellow precipitate, obtained by treating nitrate of uranium by a solution of crystallised sulphite of ammonia (which always contains a more or less considerable proportion of free ammonia). This precipitate can be easily washed in water, which, however, partly dissolves it; by drying, which can be effected at 100°, it becomes very hard, and after being pulverised shows, under the microscope, small prismatic crystals. In the tube the matter disengages sulphurous vapours and free ammonia; with energetic acids it gives sulphurous acid; uranium is present in the state of sesquioxide. The results of its analysis are:—Sesquioxide of uranium, 78·66 per cent.; sulphurous acid, 12 per cent.; ammonia, 2·28 per cent.; water, 6·02 per cent. From this it would seem to be a mixture of uranate of ammonia and sulphite of oxide of uranyle, with the same composition as the salt studied by Girard. The analysed product contains, setting aside the water, about 66 parts of anhydrous sulphite ($[Ur_2O_2]O.SO_2$) to 28 parts of uranate ($2[Ur_2O_2]O.NH_4O$)

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* Uranium red behaves, in this respect, in much the same way as sulphide of uranyle.

† Protoxide of uranium and sulphur are also obtained by heating uranium red in presence of hydrosulphate; for this it is only necessary to heat it more and for a longer time than unaltered sulphide of uranyle.

By treating the precipitate of sulphite of uranium, in the same liquid in which it is produced, by a prolonged current of sulpuretted hydrogen, and saturating gradually with ammonia, the yellow matter undergoes some very curious changes of colour. Sometimes it passes first to dirty green, then to chocolate brown, then to red brown, and finally to blood red; sometimes it does not become green, but changes successively to orange yellow, chocolate brown, red brown, and blood red; sometimes it merely becomes orange yellow and then red. These variations depend on the relative proportions of the different bodies present; the final product is always uranium red, provided the sulphite of ammonia and the ammonia itself are not employed in too great an excess, in which case the transformation into uranium red is not effected, even by making the sulphuretted hydrogen act during an entire day, and sometimes the uranium passes into a stable solution, refusing to precipitate with the ordinary reagents. This curious phenomenon takes place when the sulphite of ammonia greatly predominates; in this case pentathionic acid is formed, with separation of free sulphur, and the liquid obtained, which contains the whole of the uranium, is coloured brown.

Immediately after the preparation of uranium red, the supernatant liquid, which should contain an excess of sulphuretted hydrogen, is completely limpid, but becomes gradually brown by contact with the air. This alteration commences at the surface of the liquid, and then descends; on reaching the red substance at the bottom of the vessel this substance also decomposes, becoming nearly black. Hence the first washings by decantation must be made quickly.

The more humid the substance the more beautiful and the brighter is its colour; after dessication and pulverisation its tone is duller. In any case its tint is rather lighter than that of uranium red obtained by the action of hydrosulphate of ammonia, and slightly approaches vermillion.

I have examined a product which during its preparation passed only through orange yellow as an intermediary tint. The substance has all the properties of ordinary uranium red, only it is attacked with more difficulty by carbonate and sulphite of ammonia. Submitted to the action of heat, a small quantity of hyposulphite of ammonia volatilises, as is the case with the uranium reds previously described.

The analysis of 100 parts of this uranium red has given 72·5 of uranium, 3 of sulphur, 0·74 of ammonia. It is impossible to discuss these results, especially as the sulphur and ammonia are in such small proportion. All that I can say is, that the product obtained by my process is probably a still more complex mixture than the uranium reds formed in hydrosulphate of ammonia.

The sulphite of soda also produces, in solutions of sesquioxide of uranium, a light yellow precipitate, which, when treated by sulphuretted hydrogen with the addition of a little caustic soda causes the formation of a uranium red. The product thus obtained is of the same colour as the others, but during washing it takes a brownish tinge.

By treating sulphide of uranyle, in presence of an excess of hydrosulphate of ammonia, by a current of sulphurous acid, no red matter is produced.

On account of their warm brilliancy the various uranium reds might be of great service in painting could they be preserved in oils. Unfortunately they gradually alter by contact with these liquids; the most persistent much resembles burnt sienna.

This alteration takes place less quickly with uranium reds directly prepared than with those obtained with hyposulphate of ammonia.—*Moniteur Scientifique*, vi., 469, 64.

*On the Black Stones which fell from the Atmosphere at Birmingham in 1858**, *by Dr.* T. L. Phipson, *F.C.S., &c.*

These stones, which have hitherto been regarded as aërolites, fell at Birmingham in great number during a violent storm which broke over that town in the month of August, 1858. Several of these stones have been recently forwarded to me by Mr. W. P. Beale, in order that I might submit then to analysis.

They are small, angular, and black, presenting here and there a few indications of crystallisation. They act very slightly upon a magnetic needle, but the action is just sensible. They give a light coloured streak, and when finely pulverised are partially soluble in hydrochloric acid. Their specific gravity is about 2·7. They fuse with much difficulty upon the edges before the blowpipe; when heated quietly in a platinum crucible they emit a marked odour of ozone. The analysis which I have made of them proves that these stones are *not* aërolites, but small fragments of basalt rock, analogous to that which exists at a few leagues from Birmingham near the parish of Rowley. They have given me:—

Silica	46·13
Alumina	16·25
Protoxide of iron	8·86
Peroxide of iron	3·71
Lime	11·25
Magnesia	6·74
Alkalies (by difference)	3·76
Water	3·30
	100·00

It is evident to me that those stones which fell in great numbers in Ann Street and other adjacent streets of the town of Birmingham were carried there by a waterspout, as was the case, doubtless, for the curious fall of hay which I observed in London in June, 1861, and described in the *Comptes Rendus* of the Paris Academy; and for the fall of iron stone which occurred in August, 1841, at Iwan, in Hungary; the size of the pieces of this iron stone which fell varied from that of a hemp seed to that of a nut. The black stones which fell in Birmingham are about the size of nuts, to judge from those forwarded to me.

TECHNICAL CHEMISTRY.

On a New Method of Extracting Gold from Auriferous Ores,* *by Dr.* Crace Calvert, *F.R.S.*

At the present time, when the auriferous ores of Great Britain are attracting public attention, it may be advantageous to persons interested in gold mining to be made acquainted with a new and simple method of extracting gold from such ores, which presents the advantages of not only dispensing with the costly use of mercury, but of also extracting the silver and copper as well as the gold which the ore may contain. Further, it may be stated that the process can be profitably adopted in cases where the amount of gold is small, and the expense of mercury consequently too great. Without entering here into all the details of the numerous (about one hundred) experiments which I made some years since, before I finally arrived at the new method of extracting gold, which I have now the honour of communicating to the meeting, allow me to state a few facts which are necessary to give a general view of the subject. If 0·2 parts of pure and finely divided gold, obtained by the reduction of a salt of that metal, be added to 100 parts of pure sand, and placed in a bottle with a saturated solution of chlorine gas for twenty-four hours, only 0·5 of gold is dissolved. If the same experiment be repeated, but, instead of chlorine water, a mixture of chlorine water and hydrochloric acid be used, 0·6 of gold is dissolved. If, instead of employing hydrochloric acid and chlorine gas, a mixture of sand, reduced gold, and peroxide of manganese, with hydrochloric acid, are placed in a bottle, 1·4 of gold is dissolved; so that it would appear that, under the influence of nascent chlorine, the gold is more readily dissolved than when the same gas is mixed in solution with hydrochloric acid previously to being placed in contact with the auriferous sand. Still these processes leave a great deal to be desired in a commercial point of view, as more than a third of the gold remains undissolved; and the same results are obtained if the chlorine gas be generated by another method, viz., by adding to the auriferous sand a mixture of chloride of sodium, sulphuric acid, and peroxide of manganese. Being convinced, therefore, that nascent chlorine gas was a fit and proper agent for cheaply extracting gold from ores, and that it was only necessary to modify the method of operating, I allowed the mixture of hydrochloric acid and peroxide of manganese, or of sulphuric acid, peroxide of manganese and chloride of sodium, to remain for twelve hours in contact with the auriferous sand; and then, instead of washing out the solution of gold, I added a small quantity of water, which removed a part of the acting agent, and this was made to percolate several times through the sand; by which method I succeeded in extracting from the sand, within a fraction, the whole of the gold. I then repeated the last experiments with natural auriferous quartz, and easily extracted the two ounces of gold per ton which it contained. I therefore propose the following plan for extracting the gold on a commercial scale:—The finely-reduced auriferous quartz should be intimately mixed with about 1 per cent. of peroxide of manganese; and if common salt be used, this material should be added at the same time as the manganese, in the proportion of three parts of salt to two of manganese. The whole should be then introduced into closed vats, having false bottoms, upon which is laid a quantity of small branches covered with straw, so as to prevent the reduced quartz from filling the holes in the false bottom. Muriatic acid should then be added if manganese alone is used, and diluted sulphuric acid if manganese and salt have been employed, and, after having left the whole in contact for twelve hours, water should be added so as to fill up the whole space between the false and true bottoms with fluid. This fluid should then be pumped up and allowed to percolate through the mass, and after this has been done several times the fluid should be run off into separate vats for extracting the gold and copper that may contain. To effect this, old iron is placed in it to precipitate the copper; and after this has been removed, the liquor is heated to drive away the excess of free chlorine, and a concentrated solution of sulphate of protoxide of iron, or green copperas, is added, which, acting on the gold solution, precipitates the gold in a metallic form. By this method both gold and copper are obtained in a marketable condition. If silver is present in the ore, a slight modification in the process will enable the operator to obtain this metal also. It is simply necessary to generate the chlorine of the vitriol, manganese, and chloride of sodium process, taking care to use an excess of salt, that is, six parts instead of three, as above directed. The purpose of this chloride of sodium being to hold in solution any chloride of silver that may have been formed by the action of chlorine on the silver ore, and to extract the metal, the following alteration in the mode of precipitation is necessary. Blades of copper must be placed in the saline solutions, to throw down the silver in a metallic form, then blades of iron to throw down the copper, the gold being then extracted as previously directed. I think the advantages of this process are, 1st, cheapness; 2nd, absence of injury to the health of the persons employed; 3rd, that not only is the metallic gold in the ore extracted (as is done by mercury), but it attacks and dissolves all gold which may be present in a combined state, besides enabling the miner also to extract what silver and copper the ore may contain. I cannot, however, conclude without reminding you of what is generally underrated—that is, the heavy expenses which attend the bringing of the ore to the surface, its crushing and preparation to render it in a proper state for being acted upon either by mercury or by any other agents.

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* Read before the British Association Bath meeting, and communicated by the author.

Second Report on the Application of Gun-Cotton to Warlike Purposes[*]. By a COMMITTEE, consisting of W. Fairbairn, LL.D., F.R.S.; Joseph Whitworth, F.R.S.; James Nasmyth, C.E., F.R.A.S.; J. Scott Russell, C.E., F.R.S.; John Anderson, C.E., and Sir W. G. Armstrong, C.B., LL.D., F.R.S., from Section G.; and J. H. Gladstone, Ph.D., F.R.S.; Professor W. A. Miller, M.D., F.R.S.; Professor E. Frankland, Ph.D., F.R.S.; and F. A. Abel, F.R.S., from Section B.

YOUR Committee on the Application of Gun-Cotton to Warlike Purposes has simply to relate the circumstances that have taken the matter out of their hands. When the Committee was re-appointed at the Newcastle meeting, another recommendation relating to gun-cotton was passed by the Association—namely:—

"That it appears from the Report presented at this meeting by the joint committees of chemical and mechanical sections, and by the discussions which have followed its presentation, that the subject of gun-cotton is possibly one of very great interest and public importance; and that whilst the General Committee have taken measures to continue on their own account the inquiries which have been presented in the last year, they are sensible that the British Association does not possess means for its adequate examination; they are desirous, therefore, of drawing the attention of Her Majesty's Government to the importance of a full and searching inquiry, conducted by a Royal Commission, into the various practical applications connected with the public service, for which this material may be suitable, and that with this view the Assistant General Secretary be requested to cause the Report, with its accompanying documents, to be printed with as little delay as possible, and copies presented (accompanied by the resolution) to the Right Hon. the Secretary of State for War, by a deputation consisting of the President and Officers of the Association, accompanied by the Presidents of Chemical and Mechanical Sections."

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[*] Presented to the members of the British Association, Bath meeting. Read before Section B.

In accordance with this resolution, as soon as the Report was printed, a copy was presented to Lord de Grey, at the War Office, by a deputation headed by General Sabine. This took place on December 11. Much interest on the subject was excited in many quarters, and a large number of the separate copies of the Report were asked for and circulated. In January the Government appointed—not a Royal Commission—but a Committee to investigate the subject in all its bearings. It consists of General Sabine as President, General Hay, Captain Brandreth, R.N., Commander Liddell, R.N., Colonel Boxer, R.A., Colonel Lovell, R.E., F. A. Abel, Esq., T. Sopwith, Esq., Professor W. A. Miller, Professor G. G. Stokes, and Dr. J. H. Gladstone, with Major Miller, R.A., as Secretary, representing thus—the army, the navy, military and civil engineering, as well as chemical and physical science, and comprising, as will be seen, three of the members of your Committee. The Messrs. Prentice, who were present at the Newcastle meeting, immediately established a manufacture of the article at Stowmarket, and which has furnished materials for many experiments on the use of gun-cotton for quarrying purposes. The Government Committee is already engaged in a systematic course of experiments relating to the manufacture and keeping qualities of gun-cotton, and its use in artillery, small arms, and engineering. Your Committee, therefore, consider that their work is accomplished, since the application of gun-cotton to military purposes is now in a fair way of being investigated with greater facilities and means than could have been at their disposal.

After the above Report had been read, Professor Abel said the subject of gun-cotton had occupied a considerable share of his attention during the past year, and he would give an account of such experiments as had been made on behalf of Government. He was happy to say that they had made considerable progress already in their researches, and it afforded him still more pleasure to be able to say that results of those researches had been of a satisfactory character. He dwelt particularly upon this fact, because it would not have escaped notice that the official reports published in France were very unfavourable. The experiments conducted by Messrs. Prentice, and by himself, proved that gun-cotton possessed a great superiority over gunpowder, both in the simplicity and safety of its manufacture. The adoption of simple precautions set aside almost the possibility of accidents. With regard to a second point— the uniformity of manufacture—it was one upon which he had endeavoured to obtain the most precise information. He found that they might rely upon the Austrian system of manufacture. The next, and most important branch of inquiry, in connexion with the properties and uses of gun-cotton, was the question of its permanence or stability. Its properties, as a material for military engineering, would be rendered nugatory if they could not place the most perfect reliance upon it. According to some persons they ought to place no reliance on gun-cotton, because it was liable to change and spontaneous decomposition. He had looked at the reports of the French chemists, and he was bound to say that, although those experiments had been conducted with great care by almost the highest authorities, he could not agree with them. He had at the present time a number of experiments in progress to ascertain the changes made by heat and exposure to light.

Upon the occasion of this Report being read in the Mechanical Section, Mr. Scott Russell stated that General Hay, of the Hythe School of Musketry, had constructed a new form of cartridge suited for the Whitworth rifle; that he had found the use of gun-cotton was clean, and had not the disadvantage of fouling the gun; that it had much less recoil, although the effect was the same; that one-third of the weight of charge was the equivalent proportion, and that it did not heat the gun. He had seen a gun fired at a target with gun-cotton from the shoulder of the general at 500 yards. Twelve successive shots were all placed in a space one foot wide, by two feet high, and the value of the practice was measured by the fact that the mean radius of deviation from the centre was between nine and ten inches. Thus, therefore, the use of gun-cotton in musketry had been proved by English-made gun-cotton in English rifles by an English general, to perform all that the Committee last year reported of Austrian gun-cotton on the faith of the Austrian General Lenk. The next application made during the past year was to the driving of tunnels, shafts, and drifts in connexion with engineering applications. It was stated by the Committee that one-sixth of the weight of charge of cotton was equal in blasting effect to gunpowder, and this had been proved in practice in a number of instances. At Wingerworth colliery one-thirteenth of the weight of gun-cotton as compared to gunpowder; in the slate quarries of Llanberis, at Allen Heads, one-seventh was required. At Allen Heads, at some lead mines, a canal was being driven seven miles long. The drift was seven feet by five in the hardest limestone. Both ends were worked by gun-cotton fired by an electric battery. The great advantage experienced was that the air was not contaminated by smoke, and that the work could be carried on more rapidly. The next application had been made to the detaching of large masses of rock. This had been tried in several places, and it was found that one pound of gun-cotton was able to detach from thirty to sixty tons of rock. The Government appointed a committee, naval, military, and civil—engineering as well as chemical and physical science, and that committee was already engaged in a systematical course of experiments relating to the manufacture and keeping qualities of gun-cotton, and its use in artillery, small arms, and engineering.

PHARMACY, TOXICOLOGY, &c.

On the Preparation of an Improved Wine of Iron, by H. N. Draper, *F.C.S., and Mr.* J. Whitla.*

The authors first described their observations of the action of light in promoting decomposition of the officinal wine of iron. To prevent this decomposition, which occurs even in the dark, they suggested that ammonio-citrate of iron should replace potassio-tartrate, and that citrate of ammonia should also be added, to prevent any slight precipitation that might otherwise occur when the wine was exposed to strong sunlight. The formula proposed was as follows:—

Ammonio-citrate of Iron . . .	160 grains.
Crystalline citrate of Ammonia .	60 ,,
Sherry	1 pint.

The wine thus prepared was perfectly transparent, and had no disagreeable taste.

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* Read at the meeting of the British Pharmaceutical Conference.

On the Amount of Alkaloid in Commercial Citrate of Iron and Quinine, by Mr. J. C. Braithwaite.*

The author had examined fifteen samples of this medicine, which should contain 16 per cent. of quinine, or about 25 per cent. of citrate of quinine. The following is a tabular form of his results:—

	In 100 parts. Quinine.	In 100 parts. Citrate of Quinine.
1 . . .	1·5	2·3
2 . . .	1·5	2·3
3 . . .	3·7	5·8
4 . . .	4·1	6·4
5 . . .	4·7	7·4
6 . . .	6·0	9·3
7 . . .	7·3	11·5
8 . . .	9·3	14·5
9 . . .	11·2	17·5
10 . . .	12·2	19·1
11 . . .	13·0	20·2
12 . . .	14·7	23·0
13 . . .	14·8	23·1
14 . . .	14·9	23·2
15 . . .	15·8	24·7

On a New Method of Detecting Arsenic, Antimony, Sulphur, and Phosphorus by their Hydrogen Compounds when in Mixed Gas, by* W. Bird Herapath, *M.D., F.R.S. L. and E.*

Dr. Herapath having to investigate a case of suspected poisoning by phosphorus, in which the traces of free phosphorus had disappeared, during the long interval between administration of the poison and analysis, he examined for phosphorous acid by Scherer's method, but as several of the hydrogen compounds of sulphur and arsenic, for instance, have the property of blackening the salt of silver, he eliminated these hydrogen compounds from the gas before its absorption by ammoniacal nitrate of silver, or tested the gas as it was being evolved from any of their compounds. Dr. Herapath dissolved the organic matter, stomach, intestines, and contents in dilute hydrochloric acid by heat. The room of operation being at the time quite dark, an apparatus was fixed for exhibiting any phosphoric flashes of light, as in Mitscherlich's experiment: no flashes appeared. The acid solution might, however, have contained arsenic, phosphorus as phosphorous acid, antimony as chloride, and sulphur as taurine, &c. No chlorate of potassa could be employed in oxidising the organic matter, as phosphorous acid would become phosphoric, and all evidence be lost, for sulphates and phosphates are not reducible in the hydrogen apparatus; to the liquid filtered there was added one-third of spirit of wine, and it was then ready for use. A gas evolution bottle with funnel and pipe, armed with a tube containing chloride of calcium, and chalk in coarse powder, for the preparation of pure hydrogen gas, was got ready and tested, as usual, for arsenic. To the exit lamp was attached a green glass tube, well supported, passing over two or three spirit-lamp fumes. The exit pipe was bent at right angles, to go through a wide-mouthed bottle, containing slips of white filtering paper, dipped in a solution of nitro-prusside of sodium, made alkaline by ammonia, from which the gas was carried to the next bottle, containing ammoniacal nitrate of silver; and there was another exit tube leading to a bottle of some salt of lead, or this may be replaced by a jet for burning the gas. The apparatus being at this period ready for use, pure zinc sulphuric acid and distilled water were placed in the hydrogen evolution bottle, and the stream of gas allowed to escape through the apparatus, heat being applied to the tubes with spirit-lamps. Now, if arsenic had been present it should have produced a crust in the usual place, and antimony would, if present, have been deposited at a spot near it. Whilst sulphur would partly have been sublimed and deposited in front of the arsenic, and the remaining undecomposed sulphuretted hydrogen gas would have communicated a deep purple blue tint to the paper charged with the ammoniacal nitro-prusside of sodium. Whilst the phosphoretted hydrogen, passing unchanged through all these tests, would have been at once seized by the ammoniacal nitrate of silver, and have produced the black phosphide of silver, whilst the hydrogen escaped through the lead solution without changing its colour, unless the evolution (supposing phosphorus to be present), of phosphoretted hydrogen would have been too violent for the perfect reaction of the silver salt. It was now possible to examine the prepared organic liquid with this apparatus, by inserting it in quantities of only a few drachms at a time into the hydrogen bottle, through the tubulated funnel, and by employing sufficient spirit, no frothing took place to endanger the success of the experiment, but should it occur it could at any moment be checked by the addition of a little spirit down the funnel. Did the tubes show no deposit, and if the paper remained white, neither arsenic, antimony, nor sulphur could be present. The black precipitate in the silver bottle would inferentially have been phosphide of silver, but it admitted of absolute proof by testing with Scherer's process. The operation being completed, the silver salt was passed through a filter previously washed with acetic or nitric acid, and afterwards with ammonia, and the collected black precipitate submitted to proof by burning the filter paper, acting on the ashes with nitric acid and heat until oxidised, the silver precipitated by pure hydrochloric acid, and the solution filtered. It contained all the phosphorus as phosphoric acid, which could be tested by the nitrate or chloride magnesium with ammonia, whilst the characteristic crystals of triple phosphate ammonia and magnesia should be examined in the microscope and identified by the action of polarised light and by the measurement of their angles in the goniometer, or the phosphoric acid may be tested by a solution of nitrate of silver with ammonia, when the yellow phosphate of silver would be obtained, and the blue phosphate of iron with a solution of its proto-salt. An objection might be raised to the testing of the ashes of a filter, as the fibres of paper might contain phosphate, which an acid washing would not remove, but which could be found after incineration by the same method. It was, therefore, better to burn the phosphoretted hydrogen, and condense the phosphoric acid vapour, and test the liquid for that acid by the above method. A single drop of dilute solution of phosphorus and phosphoric acids furnished abundant evidence of crystals of the ammonia and magnesium salt when a glass slide with a drop of distilled water on it had been inverted for a few seconds over its flame. When combustion of the gas is to be the method of proof, the silver solution should be removed to a small hard glass jet inserted in the end of the tube from the ammoniacal nitro-prusside of sodium bottle; the gas being inflamed may be treated as above, but to get sufficient evidence of minute traces of phosphorus it would be well to burn the gas in a glass globe, kept cool by damp cloths round it, and the issuing stream of gas passed through a perpendicular tube surrounded by a freezing mixture, and the condensed water collected in a bottle by Mitscherlich's process, then by washing out the bottle, tube, and globe with distilled water, and concentrating by evaporation, it may be tested as before.

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* Read at the meeting of the British Pharmaceutical Conference.

* Read at the British Association Bath meeting. Communicated by the author.

PROCEEDINGS OF SOCIETIES.

CANTOR LECTURES.

"On Chemistry Applied to the Arts." By Dr. F. Crace Calvert, *F.R.S., F.C.S.*

Lecture VI.

Delivered on Thursday Evening, April 28, 1864.

Flesh, its chief constituents, boiling and roasting. *Animal black*, its manufacture and applications. Various methods of preserving animal matters. Employment of animal refuse in the manufacture of *prussiate of potash*. A few words on the decay of organic matters, and their fermentation and putrefaction.

(Continued from page 129.)

I shall now examine with you some of the various causes which contribute to the destruction of animal matters, when it arises from slow decay or putrefaction. The first of these to which I shall have the pleasure of calling your attention is that observed by Dr. Stenhouse, who, in 1854, made the curious discovery that, if the body of an animal was buried in a carbonaceous mass, such as charcoal, after a few months the whole of the animal, excepting the skeleton, would entirely disappear; and what was still more remarkable was that, though the experiments were conducted within his laboratory, no unpleasant effluvia were apparent to those who were constantly there. This eminent chemist attributed the rapid and complete destruction of animal tissue in these experiments to the oxidation of the animal matters by the oxygen of the atmosphere; but to enable you fully to understand how this occurs, I must call your attention to the following facts:—Lowitz, many years since, observed that charcoal possesses the property of absorbing and condensing in its pores large quantities of various gases, and Theodore de Saussure made an extensive series of experiments, from which I extract the following data:—

One cubic inch of boxwood charcoal absorbed of—

Ammonia . . .	90	cubic inches.
Hydrochloric acid . .	85	" "
Sulphurous acid . .	65	" "
Sulphuretted hydrogen .	55	" "
Carbonic acid . . .	35	" "
Oxygen	10	" "
Nitrogen	7	" "

Consequently the absorption or condensation of a gas in charcoal appears to be in ratio to the solubility of the gas in water, and although the condensation by a solid and by a liquid may at first appear necessarily due to different causes, and therefore to bear no relation to each other, yet in my opinion these two actions are identical. Seeing that the gas is condensed by the molecular attraction of the solid, I do not see why the same attraction should not be exercised by the molecules of the liquid. The different degrees of solubility of various gases are no doubt owing to their respective physical properties, such as specific gravity, repulsive or expansive forces of their molecules, &c. I may here mention that I am now engaged in a series of experiments, in the hope of throwing some light on this interesting question.

Gay-Lussac, in his researches on the condensation of gases by charcoal, found that one gas may expel and take the place of another gas already condensed in the charcoal; and Dr. Stenhouse, following up this observation, states that the gases, vapours, and sporules generated by the putrefaction of animal substances are absorbed by charcoal and brought into immediate contact with the oxygen of the atmosphere also contained in the pores of the charcoal, while oxidising or destroying the products of putrefaction converts them into water, carbonic acid, nitric acid, &c. These important scientific observations of Dr. Stenhouse have already received practical application. Thus Mr. Haywood has established charcoal filters at the mouths of public drains, thereby arresting the escape and diffusion in the atmosphere of the noxious effluvia given off by the putrefying matters in the sewers. Further, charcoal respirators have become extensively used since Dr. Stenhouse called public attention to the valuable properties of this substance; and lastly, atmospheric filters, containing charcoal, have been successfully applied in the Houses of Parliament to purify the entering air from any noxious gases it may contain before passing into the building. The natural decay or destruction of organic matters is due to two perfectly distinct causes—one of them chemical and the other physiological. The former has been investigated by many of the most eminent chemists of the day, and no doubt can remain that the action of the oxygen of the atmosphere converts the carbon of organic substances into carbonic acid, the hydrogen into water, the sulphur into sulphuric acid, the nitrogen into nitric acid, the phosphorus into phosphoric acid, &c. Much light has recently been thrown upon these phenomena by M. Kuhlmann, who clearly shows that the oxides of iron play a most important part therein; thus that the sesquioxide of iron yields its oxygen to the elements of the organic matters; that the protoxide of iron thereby formed absorbs oxygen from the air, which reconverts it into sesquioxide, and this again yields its oxygen to a fresh portion of organic matter, so that sesquioxide of iron is a most powerful oxidising agent, it being, in fact, the condenser of oxygen and the medium of its conveyance to and destruction of organic substances. MM. Chevreul and Kuhlmann have also shown that sulphate of lime acts in a similar manner—namely, that it yields its oxygen to the elements of organic substances, and is thus converted into sulphuret of calcium, which having a great affinity for oxygen, is again rapidly converted into sulphate of lime, and thus the oxygenation and destruction of the organic matter is effected. Mr. Millon has published an interesting paper on the formation of nitre, or nitrate of potash, through the ammonia generated during the destruction of organic substances being oxidised into nitric acid, which combines with potash, if present, and if not with lime or magnesia, which are present in all soils. Mr. Millon has remarked that this important chemical reaction is effected by an organic substance called humic acid, which acid, or its homologues, exists in large quantities in all earthly loams containing much organic, and more especially vegetable, matters in a state of decomposition. Humic acid absorbs the oxygen of the atmosphere, which oxidises the ammonia into nitric acid and water. The chemical theory of the destruction of organic matters through oxidation and their absorption of plants and re-conversion into the same substances from which they were derived, such as sugar, starch, gum, oil, essences, &c., or albumen, fibrine, gluten, caseine, &c., was greatly in favour a few years since, as it appeared to fulfil all the requirements of nature. It has, however, been greatly shaken by the beautiful researches of M. Pasteur on fermentation, putrefaction, and spontaneous generation, which proves clearly that these physiological actions play a most active part in the destruction of organic substances. This most skilful chemist has demonstrated that there is no such thing as spontaneous generation, and that the notion entertained by some physiologists, that if matter is placed in favourable circumstances as to heat, light, &c., and in a proper medium, it will become spontaneously animated, is undoubtedly erroneous, and that life in all instances proceeds from a germ or egg in which the vital principle is implanted by the Creator. He proves that life, even in the most insignificant of microscopic creatures, always originates thus, and that there is no single instance of matter being animated by purely physical causes. Let me draw your attention to a few among many facts observed by M. Pasteur, proving that life is not a property of matter, like weight, elasticity, compressibility, &c., but is always the result of a germ even in its lowest development.

When arterial blood is carefully introduced from the artery into a clean vessel, and there brought into contact with oxygen, no fermentation or putrefaction of the blood ensues; and if the experiment is repeated, substituting for the chemically-prepared oxygen atmospheric air which has been passed through a tube containing pumice-stone and carried to intense heat, in this case also there is no putrefaction or fermentation; but if ordinary atmospheric air be used in the place of pure oxygen, or heated air, and left in contact with some of the same blood, this vital fluid will rapidly putrefy, which is doubtless owing to the presence in the atmospheric air of the sporules or eggs of micoderma and vibrios, or organised ferments, which give rise to the various chemical phenomena and changes of organic matters into products which characterise fermentation and putrefaction. The same results are obtained when fresh urine is substituted for blood, an important fact, proving that the germs of fermentation do not exist in the fluids themselves, and that fermentation does not proceed from any molecular or chemical change in the composition or nature of the organic substances contained in blood and urine, but that the ferment from which these phenomena proceed is to be sought for in the atmosphere. I shall substantiate this view by several other interesting observations made by M. Pasteur.

If some asbestos is heated to a red heat and plunged into a liquor susceptible of putrefaction, such as a saccharine liquor, no fermentation ensues; but if atmospheric air is passed through asbestos at natural temperature, and the latter then immersed in a similar solution of sugar, active fermentation soon takes place, proving that the atmospheric air has left on the surface of the asbestos sporules of the mycoderma vini, which being introduced with the asbestos into the saccharine fluid, originated the well-known alcoholic fermentation. Another beautiful series of experiments by M. Pasteur is the following:—He introduced into 60 small balloons a small quantity of a highly putrescible fluid, and after boiling the fluid in order to drive out the remaining air in the balloons by the formation of steam, he closed the small apertures, so that on cooling the steam condensed and a vacuum was produced. He then proceeded to open 20 of these balloons at the foot of one of the hills of the Coté d'Or, 20 others at the summit of the same (about 2000 feet high, and the remaining 20 at a point near Chamounix, and the following results were observed:—Of the first 20 balloons the contents of 15 entered into putrefaction within a few days; of the second 20 only 6; and of the third 20 only 2 gave signs of fermentation. These results, as well as some others published by M. Pasteur, prove that the sporules or germs of putrefaction and fermentation exist in all parts of the atmosphere, but more abundantly in the lower strata, which are necessarily in contact with great quantities of organic matter in a state of decay, and that these sporules become scarce in the upper regions, which are further removed from the source of pollution. Further, he has proved, as I stated in my last lecture, when speaking of the preservation of milk, that fluids extremely liable to fermentation or putrefaction may be prevented from entering into those conditions by heating them to 250° or 260°, a temperature at which the sporules cannot resist decomposition in the presence of water. M. Pasteur has advanced a step further in this interesting inquiry, for he has demonstrated that there are two distinct phases in putrefaction. In the first there are the vibrios produced in the bulk of the fluid containing animal matters in solution, and these microscopic animals unfold the organic substances into more simple compounds; in the second phase, there are produced on the surface of the fluid cryptogams, which he calls mycoderms, and which absorb oxygen from the air, and oxidise the products developed by the vibrios. In the case of the fermentation of vegetable substances, such as saccharine matters, there are mycoderms (*Mycoderma vini*), which unfold them into, say alcohol and carbonic acid, while other mycoderms (*Mycoderma aceti*) are produced, and grow on the surface of the fluid, oxidising the alcohol into water and acetic acid. He therefore concludes that the animal vibrios and vegetable mycoderms exist abundantly in nature, and that they must be and are the most active causes of the destruction of vegetable and animal substances which have fulfilled their vital function on the earth, reducing them into water, carbonic acid, ammonia, sulphuretted hydrogen, &c., which, in their turn, become the foods of a succeeding generation of plants and animals. We may therefore truly say that death is life in the constantly reviving world.

M. Pasteur has observed another most curious fact connected with these microscopic beings—(I say microscopic, because it requires a most powerful instrument and high powers to distinguish them, and to ascertain that vibrios possess a vibratory motion while mycoderms are stationary)—this is, that vibrios are the only animals which can live in pure carbonic acid, and which are killed by oxygen even diluted with another gas. Oxygen is essential to the life of mycoderms, and some of them can also exist in carbonic acid. Lastly, M. Pasteur has noticed that if a very small amount of yeast is added to a saccharine fluid, the yeast will not materially increase in quantity, because the new generation which is produced lives on the remains of its parents; but if phosphate of ammonium or of lime and some sal ammoniac is added with the yeast, the latter will rapidly increase and occupy several times its original bulk. It is curious to observe that these microscopic cryptogams require the same kind of food as man. Thus they require nitrogenated food—so do we. They require mineral food, as phosphates—so do we. They require respiratory food—so do we. They produce carbonic acid as part of their vital functions—so do we. I cannot do better than conclude this part of my subject by giving the following table descriptive of the various ferments observed by M. Pasteur:—

FERMENTATION.

Mycoderma vini.	Unfolds sugar.	Alcohol. Carbonic acid. Succinic acid. Glycerine.
Mycoderma aceti.	Oxidises alcohol.	Acetic. Water.

PUTREFACTION.

Infusorial Ferments.

Vibrios, unfold animal substances.

Bacteria, oxidises organic matters of an animal origin.

I should mislead you, however, if I did not call your attention to another class of fermentations, which are chemical in their nature and in their action. This, for example, is the case when bitter almonds are crushed and mixed with water. The amygdaline they contain is decomposed into prussic acid, hydruret of benzoil, &c., by the ferment they contain, which is called emulcine. Again, when black mustard is reduced to meal, and placed in contact with water, the myronic acid it contains is decomposed into the essential oil of mustard, a most corrosive fluid, and this is also effected by a special ferment called myrosine. Again, when malt is mashed with water of a temperature of 170°, its starch is converted into sugar by a ferment called diastase. We also know that the starch which we take into our stomachs as food is converted into sugar by animal diastase, which exists in the saliva as well as in the pancreatic juice, and that this conversion is identical with that which takes place in the mashtub. In fact, the whole of the changes which our food undergoes to render it fit for assimilation in the digestive organs of the body may be considered as a series of different fermentations. What gives a further interest to these chemical ferments is, that not only are they all nitrogenated, and possess a similar composition, but they present many identical properties, still each has its own peculiar action; that is, it will only cause fermentation in those matters which have been placed by nature in contact with it. Thus diastase will not convert amygdaline into prussic acid, hydruret of benzoil, &c., nor will myrosine convert starch into sugar.

In conclusion, it is certain that our knowledge of these interesting phenomena of putrefaction, fermentation, &c., is yet in its infancy, and there is no doubt that many important discoveries in this intricate branch of knowledge will from time to time be brought before the world, and reward science for its persevering efforts.

[This lecture concludes Dr. F. C. Calvert's course as delivered before the Society of Arts; on delivery they were listened to with eagerness by a numerous auditory, and have now been read with no less pleasure than instruction.—Ed. *C. N.*

ACADEMY OF SCIENCES.

September 19.

M. Pasteur made a communication on the "*Phosphorescent Light of the Cucuyos*," coleopterous insects very common in Mexico. The light emitted by these insects is so intense that one will enable a person to read in the dark at a short distance from the animal. Mexican ladies ornament themselves for evening parties with the insects, keeping them for the purpose, feeding them on sugar, and giving them a bath once or twice a day. The light examined by the spectroscope gives merely a continuous spectrum, very beautiful, says M. Pasteur, but without lines. He made the same observation with the light of glow-worms.

M. Monier presented a note on the "*Assay of Animal Charcoal.*" The deterioration of animal charcoal, according to the author, is attended with an increase of carbonate of lime, and a decrease of nitrogenised carbon in the charcoal. Thus, in fresh he found 5·1 per cent. of carbonate of lime, and 10·5 per cent. of this "nitrogenised carbon;" while a sample of exhausted charcoal contained 16 per cent. of chalk, and only 4 per cent. of nitrogenised carbon. We need not quote the author's process, which is simply estimating the moisture, chalk, and carbonaceous matter in the usual way. The amount of carbonaceous matter of course determines the value of the charcoal.

MM. de Luca and Ubaldini presented a paper entitled "*Chemical Researches on Asparagine Extracted from the Tubers of Stigmophyllon Jatrophæfolium*," one of the Malpighiaceæ indigenous in the Brazils. It seems to be identical with the asparagine from ordinary sources. The authors conjecture that asparagine may be found in almost any plants at a certain stage of their growth.

NOTICES OF BOOKS.

The Laboratory Guide for Students of Agricultural Chemistry. Arranged by A. H. Church, M.A., Professor of Chemistry in the Royal Agricultural College, Cirencester. London: Van Voorst. 1864.

What a plant feeds on, or rather, what is necessary to its growth, is now pretty generally known; how it feeds is another, and, though quite as interesting, to us at the present moment, a less important matter. When it is known what are the constituents of a plant, it is the agriculturist's business to see that all these are present in the soil or supplied in the manure. Hence it is to the farmer's advantage to be a chemist. The fact is as yet but imperfectly recognised by the class, but still the students of agricultural chemistry are numerous, and continually increasing in number.

Mr. Church's book appears opportunely, since a work of the kind has been for some time wanted. The agricultural student has no necessity to make himself profoundly acquainted with analytical chemistry. The number of substances which require his attention is not large, and the object of the examination is always definite. Under these circumstances, he requires special and definite instruction, and it is this which Mr. Church has set himself to supply. After giving preliminary general directions for the detection of all the substances likely to be met with in agricultural materials and produce, which necessarily includes all but the rarer elements, the author devotes the remainder of the work to special methods for the quantitative analysis of soils, cattle foods, manures, and water, and a few examples of agricultural produce.

The former part of the work may be commended to all studying analysis for the admirable clearness and completeness of the instructions, and the book may be taken with advantage as a guide for junior students in all laboratories.

The second part, giving directions for the quantitative analysis of manures, soils, feeding materials, &c., contains all that the ordinary agricultural student requires, and we may content ourselves with recommending the work to all engaged in the study of agricultural chemistry.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2079. John Edward Grisdale, Cranbourne Street, Middlesex, "Improvements in apparatus for washing photographic prints."—Petition recorded August 23, 1864.

2088. Arthur Auckland Leopold Pedro Cochrane, Portsmouth, Hampshire, "Improvements in apparatus for heating and evaporating liquids and fluids."—Petition recorded August 24, 1864.

2116. Peter Armand le Comte de Fontainemoreau, Rue de la Fidélité, Paris, France, "Certain improvements in the manufacture of artificial stone."—Petition recorded.

2137. John Stenhouse, Rodney Street, Pentonville, Middlesex, "Improvements in rendering certain substances less pervious to air and liquids, and also less liable to decay."

2143. Alexander Rollason, Old Kent Road, London, "Improvements in glazing and varnishing paintings, prints, and photographs, and which improvements are also applicable to plain paper, woven fabrics, leather, and other substances."—Petitions recorded August 31, 1864.

2150. Thaddeus Fowler, Seymour, Connecticut, U.S.A., "An improved method of coating pins and other articles with tin or other metal."—Petition recorded September 1, 1864.

2177. David Walker, Liverpool, Lancashire, "Improvements in arrangements for malting."

2178. Thomas Henry Baker and Thomas Woodroffe, Tonbridge, Kent, "Improvements in arrangements for malting."—Petitions recorded September 6, 1864.

2193. James Fleming, Glasgow, N.B., "Improvements in the treatment of tobacco leaf for the extracting of juice or liquor therefrom."—Petition recorded September 8, 1864.

2229. Robert Francis Fairlie, "Improvements in the manufacture of artificial fuel."—Petition recorded September 12, 1864.

2235. Alexander Carnegie Kirk, Bathgate, Linlithgowshire, N.B., "Improvements in the manufacture of ice." Petition recorded September 13, 1864.

Notices to Proceed.

1092. Frederick Leisz, New Coventry Street, Leicester Square, Middlesex, "Improvements in the manufacture of syrups."—A communication from Jean Jaques Grosheinz and Anguste Sheurer, Longalback, near Colemar, Haut Rhin.—Petition recorded April 30, 1864.

1114. Edwin Henry Newby, Leicester, "Improvements in the manufacture of iron and steel."—A communication from Anthony Leonard Fleury, New York, U.S.A.—Petition recorded May 3, 1864.

1124. John Potter, Manchester, "A new compound or composition for artificial stone, and for certain machinery or apparatus to be used in mixing and applying the said composition."—Petition recorded May 4, 1864.

1136. Edward Beanes, Argyll Street, Middlesex, and Conrad William Finzel, Bristol, "Improvements in sugar boiling."—Petition recorded May 5, 1864.

1166. Henry Woodward, Euston Road, Middlesex, "Improvements in apparatus for carburetting gas."—Petition recorded May 7, 1864.

1173. Francis Herbert Wenham, Clapham, Surrey, "Improvements in motive power engines worked by explosive mixtures of gas or vapour."—Petition recorded May 9, 1864.

1192. James Brown, Aldgate, London, and Astley Paston Price, Lincoln's Inn Fields, "Improvements in the manufacture of blotting-paper."—Petition recorded May 11, 1864.

1211. Edward Myers, Millbank Row, Westminster, and Thomas Guy Rogers, Cambridge Street, Pimlico, Middlesex, "Improvements in wet gas meters."—Petition recorded May 13, 1864.

1218. Alfred Fryer, Manchester, Lancashire, "Improvements in treating animal charcoal in the process of revivification, and in apparatus employed therein."

1229. Louis Bricout, Reims, France, "Improvements in apparatus employed in carburetting gas."—Petitions recorded May 14, 1864.

1270. Joseph Freeman, Edward Grace Freeman, and Charles Henry Freeman, Battersea, Surrey, "Improvements in treating oil and spirit varnishes, and also drying oils and turpentine, in order to bleach and otherwise improve the same."—Petition recorded May 19, 1864.

1374. William Clark, Chancery Lane, Middlesex, "Improvements in the mode of treating animal, vegetable, and mineral matters, whereby to effect their dessication, vaporisation, decomposition, reduction, fusion, or volatilisation, and in apparatus for the same."—A communication from Henri Adolphe Arcbereau, Boulevart St. Martin, Paris.—Petition recorded June 2, 1864.

1386. William Clark, Chancery Lane, London, "Improvements in electro-magnetic and magneto-electric apparatus, and their application as a stationary or locomotive driving power."—A communication from Jean Henry Cazal, Boulevart St. Martin, Paris.—Petition recorded June 3, 1864.

1401. James Napier, Glasgow, Lanarkshire, "Improvements in separating certain metals and metallic substances from ores and other matters."

1408. William Clark, Chancery Lane, Middlesex, "Improvements in the preparation of phosphates of ammonia and ammoniaco-magnesian phosphates."—A communication from Emmanuel Adrien Lesieur, Boulevart St. Martin, Paris.—Petition recorded June 6, 1864.

CORRESPONDENCE.

Continental Science.

Paris, September 27.

M. Tribaut, a French mining engineer, has lately discovered a very rich vein of cobaltiferous copper, containing nearly 9 per cent. of oxide of cobalt, near Oviedo, in Spain. He has entered into an agreement with an English house to take nearly the whole produce of his mines. When will the minerals of Spain receive the attention they want from English mining engineers? The wonderful display of minerals shown in the Spanish department of the International Exhibition of 1862 seemed to indicate that Spain is richer in mineral products than any other country in Europe, and yet how few mines are worked. I fancy if any of your numerous mining engineers were to spend a holiday in Spain amongst the mineral districts, he would be amply repaid by many profitable discoveries.

The Abbé Moigno, the indefatigable editor of *Les Mondes*, has in his possession at the present moment several living specimens of the Mexican fire-fly, which have been sent to him from that country. He exhibited them at the last meeting of the Academy, before which M. Pasteur had submitted the light given out by these beautiful creatures to spectral analysis, and finds it free from lines. It differs from solar light only by the yellow portion of its spectrum being of slightly greater extent. The benevolent Abbé has been besieged for the loan of his insect treasures by several duchesses and countesses, who are anxious to put them to the same use as the Mexican ladies. As it seems possible to preserve these creatures for a considerable length of time, and as Mexico is now in constant communication with Paris, some enterprising artificial florist will no doubt next season import them regularly for the use of the Parisian belles.

M. Texier, one of the editors of the *Siècle*, is exceedingly wroth that M. Robin, the renowned *prestidigitateur*, has not received, at any rate, some part of the 50,000 francs prize awarded to M. Ruhmkorff, "the theatre of M. Robin," says M. Texier, "having certainly contributed more towards the popularisation of the induction coil than either the Academy of Sciences or the Sorbonne." *Apropos* of this wonderful assertion, M. E. St. Edmé falls foul of M. Texier in the last number of the *Cosmos*, and administers to him a well-merited castigation. Were M. Texier in London, I suppose he would place Mr. T. Matthews, the clown, and his hot poker by the side of Tyndall and his wondrous Royal Institution experiments.

The strictures of Mr. W. B. Tegetmeier, on the fictions and absurdities of the *Times*' "Bee-master," have been republished in several of the scientific journals here, and have aroused the laughter of the French apiarians, who innocently ask how it happens that the great English journal could allow such nonsense to be published in its columns.

The Italian papers announce that Professor Marini, a naturalist of Sardinia, has discovered a method of petrifying human bodies. It is stated that he has already made a table from petrified brain blood and bile, which has all the appearance and consistence of breccia. Fancy sitting daily on your grandfather and dining off your grandmother, while your wife and children sit round on your deceased brothers and sisters! Or, still better, imagine paving your hall with your enemies in neat squares, with appropriate inscriptions on each. It is also said that M. Marini is coming to Paris to show the Parisians how for the future every man may be his own tombstone.

On the Solubility of Gold in Nitric and Sulphuric Acids.

To the Editor of the Chemical News.

Sir,—Since sending you the note on the solubility of gold a chemist of my acquaintance has informed me that the information given was not sufficient to enable him to perform the experiment satisfactorily. I therefore send you a more complete account of the experiment performed by me.

The alloy of silver and gold was exposed to the action of nitric acid until the gold was left in a powder. On heating this powder with sulphuric acid a yellow solution was obtained, which, when poured into water, gave a purple precipitate. This at first led me to suppose that the sulphuric acid had dissolved some gold; so after washing, the gold was heated for some time with strong sulphuric acid, without any solution taking place; but on adding a little nitric acid an immediate yellow colour was observed in the liquid, and on pouring it into water the same blue precipitate was obtained. The experiment has been repeated, and the acids were of course tested to ascertain their purity; but the solution contains the gold evidently in a different state of combination from that produced by dissolving in nitric and hydrochloric acids, for it is again precipitated by water.

A tenth of a grain was easily dissolved in this manner; but had the heat been continued no doubt a larger quantity would have been obtained in solution. I am, &c.

ARTHUR REYNOLDS.

Excise Chemistry.

To the Editor of the CHEMICAL NEWS.

SIR,—The publication of Mr. Phillips' report with the announcement of the detection of coculus indicus and grains of paradise in several samples of beer induces me to ask if you know a satisfactory test for the presence of these bodies? With regard to the first, I may say that all the processes which I have tried fail to prove the presence of picrotoxine, even when it has been purposely added; for the second I do not know any test.

Another passage in the Report is somewhat amusing. Mr. Phillips has found two tinctures made with methylated spirit. Perhaps it may be news to him to be told that all the tinctures in the Pharmacopœia are made with methylated spirit, and wholesale druggists regularly advertise them in their price lists.—I am, &c.,

A CHEMIST.

MISCELLANEOUS.

British Association.—At the final meeting of the General Committee, Mr. Galton read the list of recommendations which do not involve grants of money, and of which the following are the more important, relating to chemistry and physical science:—

"That Professor Stokes be requested to continue his report on the present state of physical optics.

"That Professor Griffith and Dr. Aikin be requested to continue their report on the transmutation of spectral rays.

"That Dr. Paul be requested to draw up a report upon the application of chemistry to geology.

"That Dr. Baker Edwards be requested to make experiments and report upon the alkaloidal principles of Calabar beans.

"That the Committee on gun-cotton be requested to continue their reports."

The following recommendations of grants of money were also read and confirmed:—

Chemistry.

Matthiessen, Professor—Chemical Constitution of Cast Iron	30	0
Gages, M.—Mechanical Structure of Rocks ..	20	0
Catton, Mr.—Analysis of Organic Acids	20	0
Williomson, Professor—Analyses of Gases of Bath Waters	20	0
Wanklyn, Professor—Hexylic Compounds ..	20	0

Separating Ores from their Gangues.—Mr. W. Clarke has patented an apparatus for separating auriferous, argentiferous, and other ores from their gangues, which is distinguished from those ordinarily used by the separating process commencing at the lower part, the gangues passing in an upward direction. It consists of a cylindrical receiver of metal mounted on a frame, with a hollow axis passing down its centre, and to the lower end are applied the winge or blades receiving rotary motion from bevil wheels mounted at the upper part of the apparatus. The ore to be separated is received in a hopper at the top of the apparatus, which may have an oscillating motion imparted to it; a jet of water is also introduced for the purpose of carrying the ore down into the cylinder. The ore is conveyed through the hollow axis to the lower part of the apparatus, where it is acted on by the blades, which in rotating produce the separation of the gangues and cause them to enter two compartments forming a double casing round the inner chamber. The cylindrical chamber, as also the outer casing, should be completely filled with water; suitable cocks and a manhole are applied at the bottom part of the receivers, the gangues passing out of the cocks of the outer casing, while the rich ore is withdrawn by means of the manhole.—*Mining and Smelting Magazine.*

Erosion of Lead by Insects.—A letter to the *Times*, signed "Y," states that the erosion of lead by certain species of insects is not generally known, and may be extremely mischievous. Not long ago it attracted the attention of the French Academy of Sciences, and several communications upon it have been published in their proceedings, the *Comptes Rendus*. In 1858 Marshal Vaillant exhibited to the Academy leaden bullets brought back from the Crimea, in some of which the larvæ of insects had excavated circular passages three or four millimetres in diameter; but nothing of the kind had been detected in the cartridges of the Russian army in the Crimea, and the insect which damaged the French cartridges appears to have been imported in the wood of the cases in which they were packed. The insects do not eat the lead, but simply bore it out. In 1833 Audouin exhibited to the Entomological Society of Paris sheet lead from the roof of a building deeply grooved by insects. In 1844 Desmarest mentioned erosions of sheet lead by a species of Bostricha (*B. Capucina*), and illustrated the fact by cartridges from the arsenal at Turin. Mr. Westwood, the well-known British entomologist, has recorded observations on the perforation of lead by insects. M. Bouteille, curator of the Museum of Natural History at Grenoble, sent to the French Academy of Sciences from the collection under his charge specimens of cartridges gnawed by insects, which were found *in situ*, and the reports on the subject by Marshal Vaillant, de Quatrefages, and Milne Edwards, state the insect to be *Sirex gigas*, a large hymenopterous species, which, in the larva state, lives in the interior of old trees or pieces of wood, and which, after the completion of its metamorphosis, quits its retreat for the purpose of reproduction. Scheurer-Kestner, in 1861, communicated to the French Academy a notice of the erosion by an insect of the sheet lead of a new sulphuric acid chamber. The creature was caught in the act of escaping through the lead, having been imprisoned between it and a wooden support. But perhaps the most interesting and important case of insect erosion is that of stereotype metal, which was communicated in 1843 by M. du Boys to the Agricultural Society of Limoges.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements* and *Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

Vol. IX. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 10s. 6d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. X. commenced on July 2, 1864, and will be complete in 26 numbers.

An Old Subscriber will find the information in the *Public Ledger.*

J. Whitfield.—You can procure either through Morgan Brothers, of Bow Lane, or Sampson Low and Co., of Ludgate Hill.

Dr. Attfield.—Received, with thanks.

THE BRITISH PHARMACEUTICAL CONFERENCE AND THE SALE OF POISONS.

The meeting of the Pharmaceutical Conference at Bath may be described as a decided success. A large gathering of chemists and druggists can never be expected; but we have no doubt the proceedings of the Bath meeting will conduce to the attendance of larger numbers at meetings yet to come. The abstracts of the papers we have published show that the attention of the members was, for the most part, directed to practical matters, on which they furnished sound and useful information.

But the meeting was in other respects opportune. The recollection of a recent trial was fresh in the minds of the members, and the Medical Officer of the Privy Council had just made a report of some interest to the trade. It was not surprising, then, that the sale and dispensing of poisons should occupy a large share of attention. Mr. Deane, the president, devoted a considerable part of his opening address to the subject, and we have great pleasure in publishing to-day most of the observations he made.

In the first place, the *trade* (we hope no one will take offence at our use of the term) were fortunate in having Mr. Deane for a mouthpiece on the occasion. As the proprietor of one of the best businesses in London, as a man of known scientific attainments, and as a gentleman of high character, he is particularly well placed to defend the interests of his class; and the remarks he made on the position of the chemist and druggist and the operation of Lord Campbell's Act will be read with approval by every member of the trade. The operation of this Act on the chemist and druggist, as illustrated in the Liverpool case, is particularly hard; but we very much doubt whether public opinion will allow of any alteration of the law. Under these circumstances the custody of dangerous medicines becomes one of the most important considerations. We strongly advocate the segregation of all such articles in the *repertorium toxicorum* suggested by the Committee of the Conference. The objection usually made against this system—namely, that patients, seeing a prescription made up with ingredients from a "Poison Cupboard," would often refuse to take the medicine—is by no means fanciful.

Within our own knowledge, patients who have made out the words "arsenic" and "strychnia" in their prescriptions have absolutely refused to swallow a dose. This, however, is a matter for the prescriber's consideration, who is seldom considerate to the chemist. Let the chemist, therefore, take care of himself, and spare no pains to make poisonous remedies conspicuous either by locking them up, or by giving to the vessels containing them as eccentric an appearance as possible. We may, in fact, endorse all the suggestions of the Committee on "shop arrangements" and "dispensing," as well as those on the sale of such poisons as must be retailed. Many accidents will no doubt be prevented by adopting them; but if not, the chemist will have the satisfaction of knowing that he has done all in his power to prevent mischief. But what care that a druggist could take, or what Act of Parliament could prevent such *accidents* (!) as those related by Mr. Deane from his own acquaintance, to which we might add some others from our own experience?

We intended to make some remarks on the statistics of poisoning, as detailed in the Reports of the Conference Committee, and the Medical Officer of the Privy Council, but these we must defer until next week.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Occurrence of Indigo in Purulent Discharges, by William Bird Herapath, *M.D., Lond., F.C.S., F.R.S. L. and E., M.M.S.L., &c., &c.*[*]

Some time ago I had the pleasure of directing the attention of the members of the British Medical Association to the frequent presence of indigo, or of a substance which by oxidation became indigo, in the urine of patients who suffered from albuminuria, either as the result of Bright's disease of the kidney, or as a more scanty morbid product in that form of albuminuria produced as a sequela of scarlatina; and I brought forward two well-marked cases in which this peculiar colouring principle had been found by me in two patients who had been under my professional care. At that time it will be recollected by some of those who are now present, I obtained it in sufficient quantity to be able to exhibit it to the members, and even to demonstrate the crystalline character of the indigotine by preparing specimens of the sublimed crystals, which were very readily exhibited in the microscope, upon employing Ross's quarter objective for their examination. Since that period we have been instructed by Heller, Schunck, Virchow, and others that urine even in the healthy state contains a substance from which an indigo blue pigment may be obtained in traces, or excessively small quantities, and Kletzinsky has shown us that the urine of the horse and the cow contains a comparatively large quantity of this pigment-forming substance; whilst the same observer has even discovered that the exhibition of creosote and oil of bitter almonds as medicinal agents appears to have the power of increasing the quantity of indigo obtainable from the urine of the patients who have been under treatment with these substances.

It is remarkable, however, that indigo very rarely appears to be eliminated directly from the body in its markedly blue colour; on the contrary, it is thrown off rather in the colourless form, or in the shape of indican or of uroxanthine, as its name imports, a light yellow substance, which upon treatment with acids splits up into three other substances, two pigments named uroglaucine or indigo blue, and urrhodine indigo red, whilst a saccharine substance is also separated in notable quantity. So that uroxanthine may be considered as a glucoside, in which indigo blue and indigo red are present, but invisible as colouring matters, but capable of being produced by the action of fermentation, oxidation, or the destructive action of the mineral acids, as hydrochloric and sulphuric acids.

It will also, perhaps, be recollected by the members that even in the indigo plant the colouring material does not exist ready formed, but that it requires a peculiar process of fermentation and oxidation to be carried on in the expressed juices of the plant during a considerable period, in order to obtain this valuable blue in any quantity.

The occurrence of the vegetable product indigo in the fluids eliminated from the human body was considered an instance of the deterioration of the animal elements as remarkable as the presence of grape sugar in the blood and urine of diabetic patients, or the extraction of dextrine or hepatine from the liver, or the discovery of amyloid substance in the tissues of diseased organs. But it is now known that there are numerous proximate principles, which, though usually obtained from the vegetable kingdom, are, however, common to both the animal and vegetable worlds; and I may instance:—Benzoic $C_{14}H_5O_2O$, and oxalic acids $C_4O_6 2HO+{}_4HO$; dextrine or gum, $C_{24}H_{20}O_{20}$; glucose, $C_{24}H_{21}O_{21}$; indigo blue, $C_{16}H_5NO_2$, indigo red, albumen, and other proteine compounds, together with fat and many of the fatty acids and their products of oxidation and decomposition. Now, pathologists and physiological chemists are tolerably well agreed that the source of the indigo-forming substance in the animal economy may probably be due to destruction of some of the proteine compounds, and more especially hæmatosin, the well-known colouring matter of the blood globules, for we invariably find that the blue pigment predominates in those diseases in which great destruction of blood pigment occurs, as in albuminuria, phthisis, scarlotina, and such like diseases which are productive of great and excessive anæmia.

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[*] Read in sub-Section D, British Association, Bath.

In those cases in which I found indigo in the urine of patients suffering from granular kidney the blue pigment only developed itself after considerable delay in bottles partly filled, but corked. Under these circumstances, the urine underwent ammoniacal fermentation from decomposition of the urea, and the oxygen of the air in the bottle produced the blue deposit of indigo as a film upon the surface of the urine of a deep purple colour, but having a coppery tinge when examined in some angles of reflection.

This substance, when treated with potassa and protoxide of iron, with the assistance of heat, was readily deoxidised, and again changed into the colourless form of indigo so well known to calico printers and others in the habit of using this valuable dye; and, as I before observed, crystallised in six-sided plates and aciculæ of a deep blue colour when cautiously sublimed.

I am not aware that any observer has pointed out the presence of indigo in any other animal fluid than urine, although Carter has from certain reactions inferred the presence of indican in human blood. The following case, therefore, is one of peculiar interest, as I believe it is the first instance in which pus or its serous liquor puris has been shown to contain any blue pigment of this character.

The subject of the present case was a coachman, aged about 36, married, and the father of two children. He came under my care in the month of September last, and was then suffering from an enlargement of the knee-joint, but apparently without any fluid effused in the synovial membrane. The bones themselves were evidently enlarged, and a certain amount of fixture appeared to exist, which made me almost apprehensive that anchylosis had taken place. This disease of the knee, however, did not make him incapable of walking, as he was able to come to my house from Bedminster, and he did not at that time complain of his knee at all. It gave him no pain or anxiety, as it had been of long standing, but he consulted me more especially for a large swelling over the gastrocnemius of the same leg, the left, which was, though tense, fluctuating, and it evidently contained fluid.

It was not painful on pressure, and did not look like an abscess, or as being the result of inflammatory action. It was punctured, and a large quantity of serous fluid poured out, together with some large white bodies, which at first sight appeared like hydatids, but were afterwards thought to be masses of fat, as no distinct hydatid structure could be discovered in them. The puncture was made by my assistant on August 20, during my temporary absence from home, and when I saw him for the first time on September 7 the sac had again filled, and I removed a similar quantity of serum, together with another crop of these peculiar bodies. He walked home after both these little operations, and did not appear to suffer much inconvenience or pain. He called on me again on September 11, when the wound was enlarged, as more of these bodies appeared to be present, obstructing the opening and preventing the exit of the fluid from the sac. This sac was evidently in the substance of the cellular tissue over the gastrocnemius, as it was very superficial, and the puncture was made just on the inside of the calf. He was not seen again until the 16th, when the sac had decreased considerably in size. It was discharging well, and the opening was sufficient for all purposes, the man himself having squeezed out several more of these white masses every day since he saw me last. On September 21 he again called on me, when the swelling appeared in the same state as at the last visit, but he now complained of some enlarged glands in the femoral region, within Scarpa's triangle and below Poupart's ligament. These were somewhat tender to the touch and painful, for which he was directed to apply tincture of iodine freely twice daily. Shortly after this he became very much worse, and was seized with violent shivering fits, vomiting, and tenderness about the leg and knee, all of which he ascribed to the application of the iodine; but it was soon evident that he had an attack of violent phlegmonous erysipelas around the knee-joint, in the leg, and over the calf, which rapidly extended down even to the foot. Fluid continued to escape from the opening made in the sac, but it had now a decidedly purulent character, and the margins of the wound became very red, angry, and inflamed. During the course of the next week or more evaporating spirit lotions were used to keep down the temperature of the inflamed leg, and several large bullæ formed upon the dorsum of the foot, upon the calf, and under the ham. From these on bursting a sero-purulent fluid exuded in large quantities, and the discharge from the original wound was considerably increased. He had frequent startings and jumpings in the leg, which gave him intense agony, and his nights were sleepless unless he had strong morphia draughts or opium in some form or other. His leg was now so painful and swollen that he could not bear the least motion, and it was kept in one position—on its outer side upon a splint, and somewhat flexed at the knee. During three weeks he continued in this truly pitiable condition, and it was during this period that the cloths employed to keep his limb wet with spirit lotion, together with all the bed-clothes where the fluid had soaked through them, were found constantly tinged of a greenish blue colour, having very much the appearance of mouldy cheese, whilst the spirit and water used after a little time became equally greenish blue from having the cloths frequently wrung out in the vessel containing the dilute spirit, which was made by mixing gin with about four or five times the quantity of spring water. This peculiar colour gave me no alarm, for at first I was disposed to consider it as the natural mouldiness occasioned by the presence of microscopic fungi vegetating in the organic matters of the discharges, and I ordered some of the fluid to be saved for microscopic examination, fully anticipating that I should discover these minute plants without any difficulty.

But, to my very great surprise, I found no such organisms apparent, even with the higher powers of the instrument; whilst on repose, the bottle being full and corked, the blue colour disappeared in the course of a few hours. However, upon again taking out the cork, and exposing to the air for a short time the blue colour was again developed—chiefly at the surface of the fluid. This experiment clearly proved that the phenomenon was due to some chemical action of oxygen upon a colourless material, analogous to indigo, in its deoxidised condition.

So upon treating the blue liquid with a solution of hypochlorite of lime or soda, the colour was immediately discharged as certainly as if indigo itself had been acted upon. When treated with an ammoniacal solution of acetate of lead, the whole colouring matter was precipitated in combination with the lead. And if filtered through paper, although some of the blue pigment was retained in the meshes of the paper, some passed through from the very fine state of molecular division in which the substance was; a further deposit took place after a time in the filtrate in consequence of the oxidation it had undergone from being so freely exposed to the action of oxygen during the process of filtration. By repeating this operation several times, sufficient material was obtained to furnish other evidence of the presence of indigo blue—namely, by its solubility in hot alkalies, deoxidised by sugar or protoxide of iron—and the volatilisation of the pigment and crystallisation of the substance when submitted to cautious sublimation. It is much to be regretted that the true nature of this substance was only discovered on the eve of its disappearance, or a much larger supply could have been readily obtained.

On changing the remedial measures to poultices, which became needful in consequence of the formation of numerous abscesses along the course of the saphæna vein, and in the ham, upon the dorsum of the foot, and round the ankle, the pus assumed the ordinary appearances, and the blue colouring matter was no longer found to develope itself; this might have been either from its having ceased to be formed, or from the poultices preventing that constant oxidation which was so essential for the production of the blue colour, from the originally colourless base.

These abscesses were very large, and discharged greatly for several weeks; extensive sloughing followed upon the dorsum of the foot, and our poor patient was greatly exhausted from the amount of the discharge, and the continued pain and want of rest, whilst it became evident that the knee-joint had become much worse since the occurrence of the erysipelas, the bones being rough and the articulation destroyed. Under these circumstances, it became a question whether amputation should not be employed to give the poor fellow a last chance of his life.

Mr. Pritchard was called in consultation, and met me on October 29, when it was decided that as soon as he could be prevailed upon to allow it to be performed, and could be prepared for the operation by the free exhibition of nourishing diet, and plenty of support and generous wine, that he should be removed to the Infirmary for that purpose as soon as ever he was able to undertake the removal to that establishment.

About a month elapsed ere this could be accomplished, during which time the active process of inflammatory mischief gradually lessened, and the system even showed some attempt to repair the mischief by cicatrising the wound upon the foot, by which, although at one time skin to the extent of many square inches had been lost by sloughing, yet, before he left home, the whole of this had been repaired, and the wound had quite healed.

On November 26, the man was carefully lowered from his bed-room window by means of a stretcher sliding down an inclined plane, and from thence he was carried to the Infirmary by bearers, who carefully avoided giving him the least shock during the journey.

From this time forth the case was under the excellent care of Mr Pritchard, who kindly took charge of him at that institution, and removed his leg after a delay of five or six weeks, which was indispensable in order to re-establish his health somewhat more to enable him to go through the operation with success, which was finally accomplished, and about two months ago I heard that he had left the Infirmary, but was at that time unable to wear a wooden leg, as the wound was not quite healed.

Note on the Probable Constitution of Kolbe and Schmitt's Colouring Matter obtained by acting upon Carbolic Acid with Oxalic and Sulphuric Acids, by J. ALFRED WANKLYN.

THE production of a colouring matter by the action of oxalic acid upon phenyl-alcohol in presence of sulphuric acid is a very remarkable thing. As yet no attempt has been made to give any explanation of the changes which take place during this process, and yet considerable quantities of a dye stuff are now being made in France in this manner.

The following hypothesis may be offered to connect together the facts as they are at present known.

Kolbe and Schmitt give C_5H_4O as the result of their analysis, state of condensation being unknown.

$$C_{20}H_{16}O_4 = C_2\left\{\begin{array}{l} C_6H_5O \\ C_6H_5O \\ C_6H_5O \\ HO \end{array}\right.$$

The probable reaction in Kolbe and Schmitt's process is between carbonic oxide and phenyl-alcohol, thus:—

$$C_2O_2 + 3C_6H_5HO = C_2\left\{\begin{array}{l} C_6H_5O \\ C_6H_5O + H_2O \\ C_6H_5O \\ HO \end{array}\right.$$

The colouring matter is thus an "ethylene." Kolbe and Schmitt have observed that it is decolorised by means of nascent hydrogen. Explanation: The ethylene becomes a hydride of ethyl.

As might have been expected, it is a weak acid.

The obtaining of a blue dye from it by the action of aniline may possibly be by this equation:—

$$C_2\left\{\begin{array}{ll} C_6H_5O & H_2C_6H_5N \\ C_6H_5O + & H_2C_6H_5N \\ C_6H_5O & H_2C_6H_5N \\ HO & \end{array}\right. = C_2\left\{\begin{array}{ll} C_6H_5C_6H_5N & H_2O \\ C_6H_5C_6H_5N + & H_2O \\ C_6H_5C_6H_5N & H_2O \\ HO & \end{array}\right.$$

*On the Rate of Chemical Change,** *by* A. VERNON HARCOURT, *M.A.*

TWO years ago, at the Cambridge meeting of the Association, I communicated to this section a paper on certain cases of induced chemical action. In following up the course of experiments upon which I had then entered I became engaged in the study of various chemical changes which take place more or less slowly, and have thus been led into an inquiry as to the rate at which those changes proceed. Perhaps I may be allowed briefly to indicate the course of my investigation, for I shall thus more readily render intelligible the object of the later experiments. The principal case of induced oxidation, which I before described, was that which occurs when permanganate of potassium is added to a solution containing chloride of tin and oxygen. Under these circumstances, while a portion of the tin salt is oxidised by the permanganate, another portion is attacked by the free oxygen. A large number of similar cases have since been investigated by Kessler. My principal object was to determine what ratio existed between the two oxidations, and in scrutinising the conditions of the experiment it occurred to me to try whether the sulphate of manganese, formed by the reduction of the permanganate in the acid solution, had any influence. I found, greatly to my surprise, that this fixed neutral salt has itself the power of determining the transference of oxygen. Sulphurous acid, as is well known, when mixed with a large bulk of water which has been exposed to the air, is but slowly oxidised, and this change proceeds still more slowly when the solution is freely acidified. But if to such a solution a minute quantity of sulphate of manganese is added, the oxidation of the sulphurous acid is at once determined. It is like, so far as the result is concerned, the effect of adding a drop of sulphuric acid to a mixture of chlorate of potash and sugar. Sulphate of manganese has also the power of determining the action of various oxidising agents, as well as that of free oxygen. Professor Kessler observes that the cause of a phenomenon known to all chemists who have titred a chameleon solution with oxalic acid—namely, that the colour of the portion of solution first added disappears very slowly, but that of succeeding portions more rapidly—is that the sulphate of manganese, formed by the reduction of the first portion, hastens the subsequent action. Chromic acid has apparently no action upon oxalic acid in a cold dilute solution. The addition to this mixture of pure sulphate of manganese determines, under proper conditions, an immediate reduction of the chromic acid. How the sulphate of manganese acts in these cases is, at present, matter for conjecture. We may compare the action of this salt in determining the union of sulphurous acid and oxygen with that of nitric oxide. Perhaps in this case, as in that, an alternate oxidation and reduction takes place. If we may suppose that water can act to a small extent upon a manganese salt as it acts upon a bismuth salt, separate that is the base from the acid, then no doubt the hydrate of manganese thus displaced would absorb free oxygen, and the sulphurous acid at once reduce again the binoxide formed. At any rate, without insisting on so definite a hypothesis, it is probable that this action of the manganese salt is in some way related to the fact that the proto-hydrate of this metal has the property of absorbing oxygen from water, and parting with this oxygen to sulphurous acid. Similarly this proto-hydrate is readily oxidised by chromic or permanganic acid, and the resulting binoxide is readily reduced by oxalic acid.

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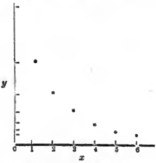
* Read before the British Association Bath meeting, and communicated by the author.

Of these actions I have selected for study that of permanganic upon oxalic acid.

When the four following substances, permanganate of potassium, sulphuric acid, oxalic acid, and sulphate of manganese, are brought together in aqueous solution, a chemical change takes place, resulting in the formation of sulphate of potassium, sulphate of manganese, carbonic acid, and water. The amount of change depends upon the amount of each of the first-named four substances, upon the dilution and temperature of the solution, and upon the time during which the substances are left in contact. As far as can be observed, these are *all* the conditions which affect the amount of chemical change in this case; it is not affected by light, nor by the agitation of the solution. The amount of change is greater, within certain limits, in proportion as the quantities of permanganate of potassium, sulphuric acid, and sulphate of manganese are greater, and the quantity of water less; in proportion also as the temperature is higher, and the time of mutual contact longer. It is greater, the larger the quantity of oxalic acid, up to that point at which the oxalic and permanganic acids are present in the proportions in which they act one upon the other; after that point, an increase in the quantity of oxalic acid diminishes the amount of chemical change. I have made many series of experiments, in each of which all of these conditions, except one, were kept invariable, and that one was varied according to a regular progression. I hoped thus, and still hope, to determine what function of each of these variable quantities the chemical change is, and so to obtain a true expression of the reaction. I made, for example, a series of experiments, in all of which I took the same quantities of permanganic acid, oxalic acid, sulphate of manganese, and water, maintaining always a temperature of 16° C., and allowing each experiment to proceed for exactly five minutes; but in the second experiment I took twice the quantity of sulphuric acid used in the first, thrice the quantity in the third, four times the quantity in the fourth, and so on. When five minutes from the moment of mixing had expired, the action was stopped, and the amount of permanganate still remaining determined. A series of numbers was thus obtained, presenting a regular decrease, which should bear an ascertainable relation to the corresponding quantities of sulphuric acid, taken, as has been stated, in arithmetical progression. This relation, however, I have not yet succeeded in determining, but in this, as in other series, the numbers exhibit the most perfect regularity. This is best seen by exhibiting the results graphically. Along the axis of x is represented that quantity, which is varied in each successive experiment; along that of y the quantity of changing substance which remains still unchanged at the close of the experiment. This quantity, it will be seen, varies rapidly at first, the differences becoming less and less as the total quantity of residual substance diminishes. The series of experiments which appeared most interesting was that in which, all other conditions being kept constant, the time during which the experiment lasted was varied. Such a series yields a curve similar to that which represents the effect of varying the amount of sulphuric acid. The curve above serves, therefore, as a general representation of such a series. It may be regarded in this case as exhibiting the course of a single experiment, showing exactly how much of the substance measured remains after the lapse of any interval. The



numbers 1, 2, 3, &c., here represent the number of minutes during which the corresponding experiment was allowed to proceed. The mode of conducting an experiment was briefly as follows:—The solution containing all the substances except the permanganate was brought to the required temperature, and the permanganate added from a pipette exactly at the beat of a seconds' pendulum. When the time had expired, the temperature of the solution having been kept rigidly constant throughout, a solution of iodide of potassium was added again at the beat of the clock. During and after both additions the liquid was strongly agitated to secure rapid and perfect mixture. The addition of iodide of potassium stops the action. The remaining permanganate is at once reduced, and liberates thereby an equivalent of iodine which can be determined at leisure in the usual way. Of such series of experiments I have made a great number. In the first instance I took the exact quantities of the different substances which react one with another, according to these equations:—

$$(1.)\ K_2Mn_2O_8 + 3MnSO_4 + 2H_2O = 2H_2SO_4 + K_2SO_4 + 5MnO_2.$$

$$(2.)\ 5MnO_2 + 5H_2SO_4 + 10H_2C_2O_4 = 15H_2O + 5MnSO_4 + 20CO_2.$$

i. e., $K_2Mn_2O_8$; $3MnSO_4$; $3H_2SO_4$; $10H_2C_2O_4,2H_2O$.

But I was led to abandon atomic quantities principally by two considerations: first, any error in the proportion of the substances becomes magnified as the experiment proceeds; secondly, the solution changes, not in one particular only, but in several. The quantities of sulphuric acid, oxalic acid, and permanganate diminish, the quantity of sulphate of manganese increases, while that of the water alone remains sensibly constant. In later experiments I have taken all the other substances in such excess, as compared with the permanganate, as to be practically, like the water, infinite in relation to it. Of all, I have taken 100 times the atomic proportion, so that the total change taking place in the solution from end to end of the reaction would be a diminution in the amount of oxalic acid, and sulphuric acid from 100 to 99 parts, and and an increase of 1 per cent. in the amount of sulphate of manganese. I found by an experiment in which the quantities at starting were varied 1 per cent., that such an alteration did not perceptibly affect the result. Under these conditions, then, one chemical substance gradually disappears, all around it remaining unchanged. A known quantity is introduced into the solution, which has from the first, where the oxalic acid and sulphate of manganese are in large excess, not a red, but a deep brown colour; the substance thus formed, and whose gradual disappearance we desire to trace, is in all probability binoxide of manganese. Having made a number of determinations after the lapse of various times we can follow exactly the course of its diminution. At first the colour changes rapidly, but as it becomes paler it fades more and more slowly. The axis of x is, no doubt, an asymptote of the curve; theoretically the whole would never disappear. The problem, then, to be determined was to find the relation between these two series of numbers—or, in other words, given this curve to find its equation. Into the details of this investigation I will not enter. Both it and a large number of the experiments already described have been performed by my friend, Mr. Esson, Fellow of Merton College, Oxford, who has charged me with the office of bringing before the Section some account of our joint work. The result at which we believe ourselves to have arrived is, that the numbers representing the quantities remaining after equal intervals of time, are in geometrical progression, and the curve consequently a logarithmic curve. This result admits of a simple and interesting interpretation. It is precisely that which would follow from the hypothesis that the dissolved binoxide exists in the fluid in the form of minute spheres upon whose unit of surface is performed a constant action. The total action thus at any moment varies with the surface exposed, and diminishes continually as the spheres, shell after shell, melt away. But the result may be explained without the introduction of an hypothesis. If we suppose the binoxide of manganese to be replaced as it disappears, so that the quantity present is always the same, chemical change will proceed, since no condition alters, at a uniform rate, a certain fraction of the whole amount disappearing in a unit of time. But since the relation between the binoxide and the solution in which it is, is not affected by a change in the quantity of the former, one of these magnitudes being infinite relatively to the other, this fraction will remain always constant when the binoxide is not replaced, but is allowed to diminish; that is to say, the amount which changes during a moment of time is directly proportional to the total amount existing in solution at that time; or, if we regard the binoxide as doing work—oxidising oxalic acid—then the statement is that the amount of work done is directly proportional to the amount of substance which at any time is there to do it. It will be of interest to examine by similar methods other cases of chemical change in solutions. If it is found, as appears highly probable, that wherever the rate of change is measurable,—wherever, that is, it proceeds slowly, and can be started and terminated at a given moment, and the amount changed or remaining unchanged determined,—it follows the same law, then we may pass inductively to a generalisation covering those cases of chemical change which take place with an immeasurable velocity, or which cannot be arrested at will, or for the determination of whose residues or products no exact methods are known. Just as by the use of the pendulum or of Attwood's machine we may prove experimentally the laws of falling bodies, when in the common case of bodies falling freely the velocity with which they move is too great for measurement.

On the Solubility of Gold in Acids,
by John Spiller, *F.C.S.*

The interesting discovery which my friend Mr. Arthur Reynolds, B.Sc., communicated to you in his letters of July 23 and October 1, has been made the subject of experiment on the part of myself and colleagues, and not only do we find Mr. Reynolds' conclusions in every way confirmed by our own experience, but the conditions involved in these remarkable reactions have, we trust, received some further elaboration by the experimental results which I now proceed to describe:—

Native gold, and more quickly the precipitated form of the same metal, are soluble on digestion with hot concentrated sulphuric acid mixed with a little nitric, with production of a yellow solution, which on being diluted with water lets fall a precipitate of gold, the colour of which is either bluish purple or bronze brown, accordingly as it is viewed by transmitted or reflected light. The tint is, however, subject to variation by the presence of extraneous salts, which have the effect of modifying the cohesion of the particles in a manner similar to that pointed out in the case of another kind of reduced gold by Professor Faraday.

If a small quantity of the yellow gold solution be poured into a porcelain capsule and left exposed to the air, a purple halo and lustrous metallic film of reduced gold will quickly be formed by the operation of the atmospheric moisture. On applying heat this effect will be counteracted, but it is difficult in a shallow open vessel to form again the yellow solution. The experiment succeeds, however, perfectly when a test tube is employed.

The character of the gold compound existing in the yellow solution is manifestly different from the terchloride and other ordinary combinations of this metal. It becomes transformed at once into the chloride of gold by the addition of hydrochloric acid, sal ammoniac, or any soluble chloride such as that of sodium, calcium, or barium, and the solution may then be diluted with water without any of the gold being precipitated. As would have been anticipated, the addition of a small quantity of common salt will slowly re-dissolve the purple deposit formed on diluting the new gold solution.

I have succeeded in rapidly producing this interesting combination of gold by arranging a plate of this metal as the positive terminal of a few cells of Grove's battery, whilst immersed in a mixture of about nine parts of sulphuric acid to one of concentrated nitric acid, and employing a piece of platinum foil or wire-gauze as the opposite pole or terminal in connexion with the zinc of the battery. Oxygen gas was freely evolved, but almost immediately the yellow colour due to the presence of gold in solution became apparent, and the passage of the electric current was continued until bright gold commenced to be deposited upon the platinum terminal, from which throughout my experiment no hydrogen gas was disengaged.

If concentrated sulphuric acid be used alone in the electrolytic cell the gold plate will likewise be attacked, but the metal is at once reduced by the nascent hydrogen which freely escapes from the platinum; so that it does not appear to be possible to prepare the new gold compound in this manner. By the use of diluted sulphuric acid there was no solvent action exerted upon the gold, but the surface of the metal soon became tarnished or iridescent by the formation of a thin and strongly adherent film of brown oxide. This result appears to have been already observed by Professor Bunsen when employing for the electro-decomposition of water (mixed as usual with sulphuric acid) an apparatus in which the platinum terminals chanced to be attached to their connexions by means of gold solder.

Further researches are required for the purpose of indicating the exact constitution of the gold compound which forms the subject of the present communication. It does not appear to be identical with the solution of gold described under the name of "sulphate of auric oxide" by Pelletier (*vide* Gmelin's "Handbook of Chemistry," vol. vi., p. 211), inasmuch as it cannot be asserted with respect to the soluble combination discovered by Mr. Reynolds, that "when gently heated it deposits metallic gold."

Chemical Department, Royal Arsenal, Woolwich, October 3.

How Sparrows Found their Way into Cuba.—In an article on "Acclimatisation" in the *Journal of Science*, by Dr. Collingwood, the author says:—"In 1830 a merchant wishing to import sparrows to the Havanna, found on arrival that the customs duties were so heavy that he could not hope to sell the birds profitably; he, therefore, let them fly—the birds entered the island free of duty, and at the end of some years their number was so much increased that in certain localities they are as numerous as they are at home."

PHARMACY, TOXICOLOGY, &c.

The Morphia Salts of Commerce, by Mr. W. E. HEATHFIELD.*

THE inquiries of the author had been directed to the amount of moisture existing in these salts, and also to the question as to whether codeia was present in them.

Three samples of hydrochlorate from different manufacturers had been examined, and found to contain, respectively, 5·8 and 9·8 per cent. of water, estimated by drying at 212°. The amount of alkaloid obtained from each of the above (dried at 212°) was 79·7, 76·7, and 74·3, the quantities thus varying inversely as the amount of water.

It was noticed that the samples containing the most moisture dissolved more readily in water, and their solution were less coloured than those which were originally drier.

Three samples of acetate were then examined in a similar way, and found to contain respectively 5, 10, and 12·6 per cent. of moisture. It was found that the sample containing least water fused and became dark-coloured, with loss of structure on application of a water bath heat, while that containing the most water retained its pulverulent form unaltered at that temperature.

The morphia precipitated from these samples was found to be remarkably pure, being perfectly soluble in caustic potash, scarcely acted on by ether, and almost entirely free from codeia, as were also the mother liquors from which they were separated.

The author also quoted experiments by Mr. How to show that, however feasible the conversion of morphia into codeia might appear on a comparison of their formulæ, it could not be carried out; a substance isomeric with codeia had been obtained, but it was by no means identical.

On Commercial Wine of Iron, with Suggestions, by F. SUTTON, *F.C.S.**

STEEL wine is well known to vary much in strength. The author obtained seven samples from the leading pharmaceutical chemists in London, and estimated the per-centage quantity of iron in them, and also the amount of saccharine residue they yielded on evaporation to dryness. The following table exhibits the results of the experiment:—

	Saccharine residue, per oz.	Metallic iron, per oz.
1 . .	23¾ grains.	0·31 grains.
2 . .	24½ ,,	0·35 ,,
3 . .	14¼ ,,	0.70 ,,
4 . .	21 ,,	0·51 ,,
5 . .	51¼ ,,	1·76 ,,
6 . .	17 ,,	1·08 ,,
7 . .	28¼ ,,	0·43 ,,

No. 5 was made with tartarated iron. The composition of the rest shows that the less saccharine residue a specimen of sherry yields on being evaporated to dryness, the more iron it is capable of dissolving. The metal should be digested in light sound sherry for four months to obtain the best preparation.

The examination of a number of samples made with tartarated iron showed that they contained about one instead of one and three-quarter grains of iron, the rest having precipitated. The author thought that if a strong sound sherry were used, and the ingredients allowed to remain in contact for one month, access of air to the vessel being occasionally allowed, a satisfactory preparation could be made by the process.

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* Read at the meeting of the British Pharmaceutical Conference.

On the Assay of the Alkaloids in Medicinal Extracts, by T. B. GROVES, *F.C.S.*[*]

THE object of the author was to devise a process for estimating the strength of the vegetable extracts used in medicine. The method he employed was a volumetric one. Mayer, of New York, and Valser, of Paris, had worked upon the same subject, and all three had fixed upon the same liquid for precipitating the alkaloid, namely, the iodohydrargyrate of potassium. All three also had suggested formulæ for the precipitate. Valser's experiments corroborated those of the author, while Mayer's pointed to a different conclusion. Mayer's experiments were then reviewed, and the details of some reactions given, from which it seems that, on adding the iodohydrargyrate to the solution of the alkaloid, a point was arrived at—the addition of either liquid caused a precipitate. In this way some of the apparent anomalies might be explained. If, however, time were allowed for the completion of the reaction, more definite results might be obtained. He described the reactions with strychnia, quinine, cinchonine, morphia, nicotina, and codeia, and reviewed Mayer's results, which were quite, he said, anomalous. In estimating the amount of alkaloid in an extract, the alkaloid must first be isolated as far as possible by Stas's well-known method. In estimating the medicinal value of an extract, more exact methods than those now known must be discovered before accuracy can be attained.

A Report as to the Purity of Commercial Powders of Ipecacuanha, Jalap, and Opium, by F. M. RIMMINGTON.[*]

THE indications relied on were principally microscopic, to which was added estimation of amount of ash, not assuming that variation in the latter particular would be proof of adulteration, but considering that such a series of estimations would be collaterally interesting. Eleven samples of ipecacuanha from different localities were examined; all appeared to be genuine, and the amount of ash was tolerably constant, ranging from 2·5 to 3·7 per cent., except in one case, where 7 per cent. was found. Nine samples of jalap had also been examined; seven of them appeared genuine, the amount of ash ranging from 5·5 to 6 per cent., while two contained an abnormal amount of woody fibre, and in these the ash was reduced to 3·5 and 4 per cent. respectively. Of eight samples of powdered opium, six were found to contain varying quantities of starch. The per centage of ash was pretty constant, from 5· to 6·5, the variations being independent of the presence of the starch. The author regards the starch as an impurity in the opium as imported, having met with it in this form.

Preparation of an Artificial Marble.—By heating aragonite in a carefully luted iron crucible, as well as lithographic stone, and chalk in a porcelain vessel stopped with emery, the authors have obtained a true marble. That obtained with aragonite especially resembles Carrara marble.—*Moniteur Scientifique*, vi., 667, 64.

PHYSICAL SCIENCE.

Mr. Rodwell's Experiments on the Trompe.[*]

THE trompe is a species of blowing machine, which is used in mountainous countries for producing a blast for smelting operations. As now constructed it consists of a large cistern, from the bottom of which proceed two vertical tubes about twenty feet long; the lower ends of the tubes pass into a wooden wind chest, furnished with a blast-pipe for the exit of air, and also with an arrangement for keeping water within it at a constant level. Immediately below the point where the tubes enter the water cistern each tube is constricted, and a few inches beneath the constriction several holes are bored in the circumference of the tubes, so that air may have free access to their interior. When water is allowed to fall from the water cistern through the tubes, a quantity of air is carried down by the descending stream, which air separates from the water, as soon as it has entered the cistern, and rushes from the blast-pipe in a continuous current.

In the *Philosophical Magazine* for last month, Mr. Rodwell has detailed a number of experiments which he made in order to determine "the most favourable conditions under which air is carried down by a stream of water, and to arrive at a satisfactory explanation of the cause of the descent of air in the different modifications of the trompe."

In regard to the etymology of the word, Grignon ("Memoires de Physique sur l'art de fabriquer le fer, d'en fondre et forger des Canons d'artillerie, &c.") states that the trompe received its name from the fancied resemblance to a waterspout. Landais derives trombe (of which trompe is the old French form) from *στρόμβος*, a top, a spindle, a round shell, which in its turn is derived from *στρέφω*, to turn, twist, revolve. The author conceives that the trompe received the same name as a waterspout "either because of the mixed column of air and water produced in certain forms of the machine, or more probably from the whirling motion of the water around a conical cavity," which would occur in many of the old forms of the trompe; in both these respects there is a resemblance to a waterspout.

The second section of the paper is devoted to the description of an instrument by means of which the amount of air carried down by a stream under various conditions can be determined with accuracy. Several tables of experiments made with this instrument are given, which show the amount of air carried down by half a litre of water, under various conditions of pressure, velocity, &c., and flowing from (*a*) a circular, (*b*) rectangular, (*c*) square, (*d*) and triangular discharge tube. The constituent of a jet of liquid moving downwards with great velocity is considered, and it is stated that when such a stream falls through a vertical tube the area of the cross section of which does not exceed a certain dimension in relation to that of the orifice from which the liquid flows, discs of water are produced in the tube, which are pushed down by the descending stream, and force down the air beneath them. If, on the other hand, the pressure on the lower orifice of the vertical tube is competent to support a column of water at a certain height in the tube, the descending stream comes into direct collision with the water, and air is then carried beneath the water surface on account of the formation (by the descending masses of water) of cavities, into which air enters, according to the theory of Professor Magnus, of Berlin.

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[*] Read at the meetings of the Pharmaceutical Conference.

[*] "On Some Effects produced by a Fluid in Motion." No. II. On the Trompe.—*Phil. Mag.* for September, 1864.

The author gives the following example to illustrate this mode by which air is carried beneath the surface of a liquid:—"We have a frequent example of this action of detached fluid masses. If we wish to pour out beer so that it shall have no froth we pour it down the side of the glass, the adhesion of which flattens the stream into a ribbon, and it enters the fluid in the glass slowly. There is no falling of detached masses here, consequently no air is carried down. On the other hand, if we wish to produce froth, we pour out the beer from as great a height as possible, and the masses detached by the accelerating force of gravity carve out channels in the liquid, into which air enters and is carried down, and afterwards rises to the surface in bubbles."

A small lead shot, weighing ·072 gramme, was found to cause 192 times its own volume of air to penetrate beneath the surface of water by being thrown into it for a height of 1¼ feet at an angle of 60 degrees.

The greatest amount of air which the author found to be carried down by a stream of water flowing from a delivery tube $\frac{3}{30}$ths of an inch diameter through a vertical tube $\frac{21}{80}$ths of an inch diameter at the rate of half a litre in 24 seconds was, (*a*) by disc action, 615 c.c.; (*b*) by direct collision, 182 c.c. per half litre of water.

We have all noticed the whirling conical cavity which forms over an orifice in the bottom of a vessel from which a liquid is escaping. If rotatory motion is given to the liquid before it commences to flow, the cavity forms at a considerable height about the orifice, and air enters through it and makes its way into the issuing stream. This is discussed in the third section of the paper. The author found more air to be carried down by this means than by any other. Water flowing from a tube $\frac{11}{120}$ths of an inch diameter, at the rate of half a litre in 39 seconds, carried down no less than 1392 c.c. of air for each half litre of water. "Stated in other words, a little stream of water about $\frac{1}{10}$th of an inch in diameter at the orifice from which it issues, with a head of water of two feet, carries down in one hour 128 litres of air."

Let us suppose a continuous vertical tube less than 33 feet long in connexion with a water cistern, and moreover that water is flowing through the tube into a vessel containing water; if we close the orifice in the cistern from which the water issues a column of water will remain suspended in the vertical tube by atmospheric pressure. Now let an orifice be made anywhere in the circumference of the tube, and the column of water beneath that orifice will immediately fall, because the atmospheric pressure below the orifice is at once neutralised, and the water descends by its own weight. If we again cause water to flow through the tube, the column below the lateral orifice will obviously have greater velocity than that above it, hence rupture will ensue at the orifice, and air will enter, the flowing water will momentarily close the orifice, air will again enter, and so on.

The fourth section of the paper is devoted to the carrying down of air by this mode, and the author found that half a litre of water flowing from a delivery tube $\frac{3}{20}$ths of an inch diameter carried down 320 c.c. of air.

In the fifth section Mr. Rodwell gives a summary of the investigation; this we give verbatim:—

"We see from the above that there are four modes by which air can be carried down by a stream of water falling through a tube.

"1. If the area of the cross section of the tube through the water-falls be not much greater than that of the orifice from which the water flows, discs will be formed in the tube, and being pushed down by the descending stream, will force down the air beneath them.

"2. If the area of the cross section of the tube through which the water falls be much greater than that of the orifice from which the water flows, so that disc action is prevented; or if the pressure on the lower end of the tube be competent to support a column of water in the tube at such a distance from the orifice from which the water flows that the descending stream has not widened sufficiently to allow of the formation of discs, air will be carried beneath the water surface on account of the formation of cavities, according to the theory of Magnus.

"3. If there is not a great depth of water in the vessel which supplies the descending stream, or if (the depth not of necessity being small) rotatory motion is from any cause imparted to the water, air will enter through a cavity formed above the orifice from which the descending stream issues, and extending into the descending stream.

"4. If the area of the cross section of the orifice from which the water flows be as great, or nearly as great, as that of the tube through which the water falls, and if, at the same time, the orifices for the admission of air do not exceed a certain area compared with that of the orifice from which the water flows, air will enter at the rupture of the stream, produced at the orifices, by the accelerated motion of the water below those orifices.

"The cause of the descent of air in the different modifications of the trompe is not due to any one action of a stream of water; air is carried down by all four of the modes of action mentioned above.

"Generally only one mode obtains in one form of the machine; but there may be two modes acting simultaneously, the particular mode or modes being determined (*a*) by the relation of the area of the cross section of the trompe tube to that of the orifice from which the stream flows; (*b*) by the head of water above the orifice from which the stream flows; (*c*) by the fact of whether there are causes which induce rotatory motion in the water before it leaves the cistern; (*d*) by the form of the orifice from which the stream flows; (*e*) by the manner in which air is allowed access to the interior of the tube; and lastly (*f*) by the amount of pressure on the lower orifice of the tube.

"The first and fourth modes least seldom obtain; the second obtains in the generality of modern trompes; and the third obtains in the trompe described by François, in trompes with very shallow cisterns, in trompes in which the water before leaving the cistern receives rotatory motion, either from the stream which supplies the cistern entering at an angle to the water surface, or from some other cause, and in all trompes with inclined tubes (of which, as stated above, Kircher had seen forty prior to the year 1655).

"I consider the most economical, and in every way the most efficient form of trompe, to be the old form, in which there are no air holes, and the air enters by a conical cavity in the water above the orifice from which the descending stream issues. It will be seen from the above that by this method we obtain nearly double the amount of air obtainable by other means. The construction of such a trompe, moreover, is comparatively easy; there is no need to have the tubes perfectly vertical, and less spray is carried into the furnace than by the form of trompe now in use."

PROCEEDINGS OF SOCIETIES.

BRITISH PHARMACEUTICAL CONFERENCE.

The following is a portion of the opening address of the President, Mr. Deane. After some remarks on the history and objects of the Conference, and some allusion to the publication of the British Pharmacopœia, the speaker proceeded to a topic which is now absorbing a good deal of attention. From this part of the address we shall make several extracts:—

"The next subject I have to refer to is one the importance of which to us, as responsible persons in the sale and dispensing of medicines, it is scarcely possible to overestimate.

"The result of the trials on the late case, the acquittal of the assistant, who is supposed to have dispensed the medicine, from the charge of manslaughter, on the score of its being a pure misadventure, and the unavoidable compromise with the friends of the deceased, show that every one of us is standing on a mine which may at any moment explode, and send us to pecuniary perdition and despair. It matters nothing what amount of care and expense has been bestowed on arrangements to secure the public from accident; it matters not that the proprietor of an establishment is in no way to blame, or that the patient has died through a pure misadventure, the law requires that a jury shall award compensating damages to the injured family. We all know what that means to nineteen in twenty of those following the business—it means utter ruin.

"Allow me to state our case and position in society as an important branch of what is called a liberal profession. In the first place—

"All the responsibilities of professional men are laid upon chemists without either the dignity or emolument. We are treated as shopkeepers, with profits less then those of an ironmonger.

"Rich and poor of all grades do not hesitate to consult them in all sorts of difficulties, and obtain freely and gratuitously that for which a physician or consulting chemist would charge a handsome fee.

"That the information thus freely accorded to all is truly valuable is proved by the fact of the constancy of the practice, and the needless jealousy of many professional men.

"To obtain this amount of public confidence, a large expenditure of means, careful observation, energy, study, and integrity of purpose, are required.

"The more extensive the business of a chemist, the greater the responsibility; but not so the profits.

"When the public confidence is secured, it is the interest of the chemist to maintain it by all and every means in his power.

"Foremost amongst the means are the obtaining good assistants, and making such arrangements in the establishment as shall, as far as practicable, obviate all chances of accident, and ensure the detection of errors, and the sources of them. Having done this, and exercising constant watchfulness, all that a man can do has been done. Proof of successful care is shown in the small number of known errors made by dispensing chemists.

"Thus, a man may dispense 50 prescriptions daily, on an average of 300 days in a year, equal to 15,000 prescriptions, each of which will average 10 doses, or 150,000 doses annually! He goes on thus for many years, and never has the faintest trace of an accident arising from any fault or oversight of his own, and for which he rarely gets a fair share of credit. But during those years he has probably corrected numberless errors of prescribers, many of them of no trivial nature; but for this he has no credit, professional etiquette requires he should be silent. If the skill and foresight of the dispenser were not habitually turned to such contingencies, serious accidents would frequently be recorded. Hence, the educated and careful dispenser, in the exercise of his skill, tact, and judgment, in avoiding the dangers incidental to his grave and responsible duties, is a benefactor to the community, and deserves better pay and higher consideration than the world is disposed to give. Yet a man, though gifted with clear intellect and sound discretion, and possessing a thorough knowledge of his business or profession, cannot after all claim exemption from that common imperfection of humanity—fallibility, and is not a bit less liable to error than the professedly more highly educated man who writes prescriptions, or the patient who carelessly takes up an opium liniment, and swallows it for a black draught, without exercising that common sense which we may safely state is the only true preventive of such accidents.

"No regulations could be devised nor Act of Parliament enforced to prevent a physician from making a wrong mark, which might lead to fatal results, nor prevent the recurrence of such facts as the following:—

"A lady of our acquaintance lately took into her hand an oval, fluted, half-pint bottle of chloride of zinc, having thereon a large red label, and 'Poison,' in large red letters, on the top of the bottle, and took a dose therefrom, instead of from a round pint bottle, having a small plain label, which she had used for two years for a soothing syrup in daily and frequent use.

"Another lady of our acquaintance went to a cupboard where medicines are kept on a middle shelf to procure a dose of fluid magnesia, but instead of taking the proper bottle standing before her face, got a chair and took a bottle of chloride of zinc from a distant corner of a top shelf, and, in spite of the red label and the word 'Poison,' took a dose, which killed her in a week.

"Such cases can be quoted by the dozen, together with numberless little inexplicable instances in daily life, of temporary absence of common sense, which serve to prove the frailty of human nature, and how powerless all rules and regulations must be to prevent their recurrence entirely.

"The case at Liverpool brings all these considerations before us in the most vivid manner. . . . . . Is a man to suffer destructive and ruinous spoilation because his assistant is not more than human? It is monstrous injustice. Who is safe amongst us if a ruinous prosecution is to follow an accident, however sad and fatal it may be, which may any day occur to any one of us,—a class of men proverbially and necessarily careful for their own existence' sake? And who will enter a profession liable to such fatal responsibility?

"A general practitioner may, and does make numberless mistakes with impunity, because the facts are confined to himself and his own surgery. The eyes of the physician and the public are not on him or his dispenser, to stimulate to vigilance and care; thus few accidents under such circumstances ever see the light, and perhaps it is well it should be so. But cases do occasionally come before the public which contrast most favourably for the order and care exercised in every well-regulated pharmacy.

"The prosecutor in the Liverpool case was probably led away by the popular delusion that every chemist's profits are enormously large, and that they must of necessity get rich out of the public,—not being aware that one-half of the chemists in the country do not, as a gross return, take 20s. per day, or 365*l*. per annum; and that the net profit earned by the other half little more than sufficed to keep soul and body together.

"Although it is now shown that the law makes the employer of an assistant responsible for the acts of the letter, I am at a loss to conceive on what principle of justice it is so, when it can be shown that no pains have been spared to prevent accidents. Without some change in the law, this must ultimately lead to the abandonment of the profession by educated and high-minded men, and their places taken by others, ignorant and reckless, and thus public safety will be jeopardised. The twelve pence now demanded for as many doses of pills, can only be adequately replaced by a sum equal to the fee of the prescriber, for it is clear we have the responsibility of two professions on our shoulders, which ought in common justice to be paid for.

"For some admirable remarks on this case, I may refer you to the *Liverpool Daily Post* of August 16 last, where you will find much that I have said, and a deal more, stated in the most lucid and forcible manner; and it will be seen how unjustly Lord Campbell's Act may be brought to bear upon a particular class of the community, and in cases where it could never have been intended it should take effect. I cannot refrain from quoting one passage, for reasons which I will not record here:—'Nay, more unlikely things have happened than for a man to commit suicide after surreptitiously mixing poison with a dose from a chemist, and so virtually bequeath to his family the damages obtainable by an action under Lord Campbell's Act. The deed is an unlikely one; but as the Insurance Companies deem it worth while to except suicide from the causes of death allowed by their policies, our supposition is not beyond the bounds of possibility.'"

ACADEMY OF SCIENCES.

September 26.

M. Scoutetten contributed a memoir, entitled "*Researches on Mineral Waters, and specially on the Cause of their Active Properties.*" This cause, according to the author, is electricity. By coming in contact with electro-magnetic currents in the bosom of the earth, the waters undergo a sort of allotropic modification, which unfortunately does not last when the water comes to the surface, but is gone in three days at most. And now the mystery of mineral waters are unveiled, the author says the medical applications may for the future be made with exactness.

M. Renault presented another note "*On some Haloid Salts of Copper.*" In this paper the author describes the photographic properties of the iodide, bromide, and fluoride of copper. The bromide of copper is most sensible to light, and the picture may be fixed by employing the ordinary hyposulphite with care. Iodide of copper is less sensible to light, and the fluoride still less. We shall give this paper with the author's previous communication on the chloride of copper.

M. Hugo Schiff detailed some "*Researches on Complex Amides.*" This ingenious chemist has formed diallylidene-diphenamide, œnanthylidene-diethyl-diphenamide, toluene-diethyl-diphenamide, allylaniline, and œnanthylidene-diallyl-diphenamide.

NOTICES OF BOOKS.

Coffee and Chicory: their Culture, Chemical Composition, Preparation for Market, and Consumption; with simple Tests for Detecting Adulteration, and Practical Hints for the Producer and Consumer. By P. L. Simmonds. London: E. and F. N. Spon. 1864.

Years ago, the legend runs, a pious Mollah in Arabia, watching his goats, noticed that after browsing on the leaves and berries of a certain shrub, the kids seemed to experience an unwonted exhilaration of spirits, and skipped and danced about with more than usual agility. Struck by the fact, and stimulated, perhaps, by his forced abstinence from the only exhilarating fluid known in these days, the pious man determined to try the effects of the plant on himself; so he gathered the leaves and berries, and made a decoction, and became the first coffee drinker. The story probably is not true, and Mr. Simmonds does not notice it; but if not true, we may say it is *ben trovato*. How men were first brought to roast the berries before they made the decoction is unknown. It may have been by some such accident as led to the method of roasting pig in China as described by Charles Lamb.

The stimulating effect of the decoction was probably the origin of the name bestowed upon the plant, which was kăhwăh, an old Arabic word for wine—a name which is retained in some form or other wherever the berry is used.

The name, or more likely the effect, of the beverage gave rise to a dispute among the Mohammedan doctors as to the legality of its use; but common sense prevailed, and coffee is drunk without concealment or qualms of conscience by the most rigid of Mussulmen.

The consumption of the berry is now enormous. Europe imports annually about 270,000,000 lbs., of which France consumes one-sixth. In 1862 the United Kingdom consumed 34,451,766 lbs., which, however, was one mil-million and a-half pounds less than in the preceding year. The consumption thus averages a pound a-year for each individual of the population; but it is not equally distributed. The Scotch consume much less than the English, and the Irish much less than the Scotch.

The above figures represent the genuine berry, but not the amount of so-called coffee consumed by the population. Mr. Simmonds has a chapter on adulterations, from which we learn that almost everything which can be dried and ground, including the livers of oxen and horses, seems to find its way to the coffee-mill under the name of "Boston." After that, it is refreshing to read the story of a gentleman who visited a large American hospital, and noticed barrels of dried coffee grounds. Inquiring the use of these, a polite official informed him that they received twelve dollars a barrel for the grounds, which were to be "re-aromatised by the transforming hand of modern chemistry," and sold in pound papers with attractive labels and under high-sounding names.

It is not necessary to inform our readers how they may detect chicory, mahogany dust, and various starch granules, but they may wish to know how to recognise horse-liver coffee. "This adulteratant," says Mr. Simmonds, "may be known by allowing the coffee to stand till cold, when a thick pellicle or skin will form on the top."

The chemical composition of the berry suggests more than a doubt of the propriety of roasting it for an article of diet. Our readers are familiar with the ingredients, but we will quote a part of Payen's analysis to support our assertion. According to this authority one hundred parts of coffee contain, among other things—

Casein	13·00
Sugar	6·50
Gum	9·00
Fat	12·00

Now, in the process of roasting, the sugar is, no doubt, converted into caramel, and thus one nutritive ingredient is disposed of. The remainder of the constituents noted above are most likely greatly modified or destroyed, especially in the more highly roasted berries, and all this destruction is effected to produce a small quantity of empyreumatic oil. We possess no analysis of roasted, but we have the assertion of Payen that slightly roasted coffee contains the maximum of nutrition, which, perhaps, comes near the truth.

How a decoction of the simply dried berries would taste we do not know, but it would probably be as agreeable as an infusion of tea, and certainly much more nutritious. The late Mr. Soyer, if we remember rightly, suggested that tea leaves should be slightly rosated to improve the flavour, and the process would not be at all more absurd than roasting coffee.

How to make coffee is a not unimportant chapter in Mr. Simmonds' book. The art may be said to be in its infancy in this country. Everywhere on the Continent, and generally abroad, good coffee is always to be had, while in this country our most expensive coffee-houses supply very inferior, and in private houses it is, for the most part, detestable. Seeing that coffee is cheaper here than in most countries, this is absurd; and we may commend the instructions in this book to all who desire to improve the beverage.

Of chicory we need not speak—no one of good taste cares for it with coffee, and no one who has any regard for his bowels drinks it alone. It makes a dark decoction, which is slightly purgative, but is destitute of all the qualities which have made coffee an almost universal drink.

In conclusion, we may recommend Mr. Simmonds' book to all readers who wish to be well informed on the subjects of which it treats.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2050. John Joseph Parkes, Paddington, Middlesex, "Improvements in the application of gas and other fluids or liquids for lighting and other purposes, and in apparatus connected therewith."—Petition recorded August 18, 1864.

2157. William Lundi Duncan, Hunter Street, Brunswick Square, Middlesex, and Sidney Chilon Child, Clapham, Surrey, "Improvements in bleaching coloured and other rags or other materials or half-stuff, and in rag-engines for paper-making."—Petition recorded September 2, 1864.

2175. John Knowles Leather, St. Helens, Lancashire, "Improvements in the manufacture of salts of chromium from chrome ore."—A communication from Benedict Margulies, Trieste, Austria.

2181. William Henry Perkin, Sudbury, Middlesex, "Improvements in preparing colouring matters for dyeing and printing."—Petitions recorded September 6, 1864.

2223. Henry Craven Baildon, Edinburgh, "Improvements in the manufacture of inks or writing fluids to be used with certain kinds of paper for the prevention of fraudulent alterations in bankers' drafts, notes, cheques, and other documents in which it is important to avoid alteration or erasure."—Petition recorded September 12, 1864.

2244. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the preparation or treatment of colouring matters obtained from aniline." A communication from H. F. G. de Clauhry, Paris, France.—Petition recorded September 14, 1864.

2267. John Barker Huntington, Furnival's Inn, London, "An improvement in the scales of aneroid barometers and of mercurial barometers."—Petition recorded September 16, 1864.

2279. David Hunter Brandon, Rue Gaillon, Paris, "Improvements in the treatment of tar oils for the purpose of employing the same as paint." A communication from Vincent Cordier, John Claudius Cordier, and John Gatliff, Paris, France.—Petition recorded September 17, 1864.

2313. Isham Baggs, Cambridge Terrace, Islington, Middlesex, and William Simpson, Maidstone, Kent, "Improvements in the manufacture of chlorine."

2317. Richard Archibald Brooman, Fleet Street, London, "Improvements in the manufacture of sugar, and in apparatus employed therein." A communication from Adolpha Leqmine, Plaguy, France.—Petition recorded September 21, 1864.

Notices to Proceed.

1236. William Wilson, Manchester, Lancashire, "Improvements in and apparatus for generating gas from hydro-carbon or other volatile oils, for illuminating and other purposes."—Petition recorded May 17, 1864.

1254. John Bilby Merrikin, Bath, Somersetshire, "Improvements in bottles or vessels for containing poisons."—Petition recorded May 18, 1864.

1262. Thomas Dunlevie, Dublin, Ireland, and John Jones, Liverpool, Lancashire, "Improvements in metallic alloys."—Petition recorded May 19, 1864.

1285. Cowper Phipps Coles, Southsea, Hampshire, "Improvements in protecting the bottoms and sides of wooden and iron ships and other submerged structures."—Petition recorded May 21, 1864.

1296. Benjamin Jones, Warriogton, Lancashire, "Improvements in the mode or method of obtaining sulphur from alkali or blue waste."—Petition recorded May 25, 1864.

1346. George Davies, Serle-street, Middlesex, "Improvements in artificial teeth, and in moulds for forming the same."—A communication from John Perrel and Joseph Stubb, Philadelphia, U.S.A.—Petition recorded May 31, 1864.

1759. Alexander Angus Croll, Coleman-street, London, "Improvements in the manufacture or preparation of material for the purification of gas."—Petition recorded July 14, 1864.

1842. David Barker, Battersea-park, Surrey, "Improvements in the manufacture of artificial fuel."—Petition recorded July 23, 1864.

2088. Arthur Auckland Leopold Pedro Cochrane, Portsmouth, Hampshire, "Improvements in apparatus for heating and evaporating liquids and fluids."—Petition recorded August 24, 1864.

CORRESPONDENCE.

Dr. Muspratt on the Buxton Thermal Spring.

To the Editor of the Chemical News.

Sir,—As so much has been said with regard to the Bath thermal water at the British Association, I think this a fitting opportunity to send you, for publication, my recent analysis of the Buxton water, which has, for many years, been so famous in the cure of rheumatism, gout, chlorosis, chronic skin diseases, &c., and which comes under the same category as the Bath and Bristol hot springs.

	Grains in the Imperial Gallon.
Carbonate of lime, $CaOCO_2$ ...	8·541
Carbonate of magnesia, $MgOCO_2$ ...	3·741
Carbonate of iron, $FeOCO_2$	0·082
Chloride of calcium, CaCl	1·227
Chloride of magnesium, MgCl ...	0·463
Chloride of sodium, NaCl	2·405
Chloride of potassium, KCl	0·260
Sulphate of lime, $CaOSO_3$	0·330
Silicic acid, SiO_2	1·044
Organic matter	0·341
Phosphate of lime and alumina, fluoride of calcium, nitric acid, &c. ...	1·076
	19·510

The thermal springs at Buxton issue from fissures in the calcareous rock, and are attended by often repeated but suspended volumes of gas, which escape partly as large bubbles and partly in countless minute vesicles of water, giving to the liquid freshly collected in glass vessels all the appearance of aerated water. As it gurgles up, the water is clear, sparkling, and almost tasteless. The temperature is a little above 82° Fahr., and the specific gravity 1·000339. On evaporating four gallons of the water to dryness, at 212°, the residue obtained weighed 78·04 grains, equal per gallon 19·510 grains.

The most remarkable feature of the Buxton water is the very large quantity of nitrogen which it eviscerates.

	Cubic inches per gallon.
Nitrogen	204·00
Free carbonic acid	8·50

To what ingredient or ingredients does the Buxton water owe its efficacy? Calcareous waters, we know, are stimulant, alterative, and constipatory, but in what way they act beneficially in cases of gout, &c., remains to be proved. Some consider their curative power to be due to the nitrogen, but how can this be, when the water can only hold *in solution* the merest trace of this gas? The imbibition of the nitrogen seems to me to be a mere theoretical speculation, and has not the slightest foundation from experiment, the only true test for any one to raise deductions upon. Few subjects connected with medicine are more interesting than that of mineral water. The circumstances attending their direction or management, the natural mode of their production, the scenery in which they are often placed, combine to impart to them, as remedies, an interest exceeding that of ordinary agents for healing or for mitigating disease. My friend Playfair analysed the water of Buxton many years ago, and it is gratifying to find our results are so much alike. In concluding, I may state that the gases in these springs are closely allied to those of the thermal water at Bath, but whether "the singular chemical character of the Buxton tepid water must be ascribed to its gaseous and not to its solid ingredients" is, as Dr. Falconer writes, "a nut that will be cracked some day."

I am, &c.,
SHERIDAN MUSPRATT, M.D., &c.,
Professor of Chemistry.

College of Chemistry, Liverpool, September 27.

MISCELLANEOUS.

Messrs. Churchill's Literary Announcements.—The publishing season may be said to open with the October session, and we have now before us the list of works now ready, or shortly to be issued by Messrs. Churchill. It includes new editions of Dr. Taylor's "Principles and Practice of Medical Jurisprudence;" Dr. Headland on the "Action of Medicines;" Galloway's "Manual of Qualitative Analysis;" Squire's "Companion to the British Pharmacopœia;" Royle's "Materia Medica," to be edited by Dr. Headland;" Waring's "Manual of Therapeutics;" the "Cyclopædia of Practical Receipts," by Messrs. Cooley and Brough;" and Beasley's "Book of Prescriptions." A new work, "Elements of Materia Medica," by Dr. W. Frazer, is announced as nearly ready.

Suggestions for the Custody and Sale of Poisons.

1. That none but qualified persons, educated to the trade of druggists, should be allowed to vend by retail drugs or medicines capable of acting as poisons.

2. That the sale of poisonous drugs by chandlers, grocers, oilmen, drapers, or small shopkeepers should be strictly prohibited. [A license might, if necessary, be granted, enabling these persons to sell certain specified medicines used by the poorer classes.]

3. That the sale of arsenic, strychnia, and other specified poisons should, after a certain date, be restricted to pharmaceutical chemists and licentiates of the Apothecaries' Society. Any other persons acting as druggists not to be permitted to sell them, until they have proved their knowledge of poisonous drugs by undergoing a proper examination.

4. Under no circumstances should boys or girls, or persons who cannot read or write, be permitted to sell poisonous drugs.

5. Some rules are required for the management of a licensed retail trade in poisonous drugs. No youth should be allowed to dispense or sell them who is not above the age of eighteen years, and who has not been for at least one year engaged in the practice of pharmacy, under a pharmaceutical chemist or licentiate of the Apothecaries' Society. This restriction not to be applied to one who has passed an examination either at the Pharmaceutical Society or at Apothecaries' Hall, as to his knowledge of poisonous drugs.

6. That poisonous drugs and medicines having a similar colour and appearance should not be kept near to each other in similar bottles, drawers, or boxes with similar labels.

7. That less facility should be given for the purchase of arsenic, strychnia, and other deadly poisons, which can be used for the purpose of suicide or murder.

8. That no poisonous drugs should be sold to girls or boys under the age of twenty years, on any pretence whatever, and that in all cases of purchase there should be a witness of adult age.

9. All poisonous drugs sold should be distinctly labelled with the name of the drug, the address of the vendor, and the date of sale.

10. That noxious substances, such as arsenic, corrosive sublimate, sugar of lead, and tartar emetic, and others of the like nature, when stored in large quantities in casks or packages, should be distinctly labelled, and kept apart from other substances of an innocent kind which they resemble. [Many of the accidents which occur from carelessness in dispensing, and ignorance in administering, medicines, might be prevented by the adoption of Mr. Thonger's patent labels, which are provided with a sand-paper border.]—*Report of Medical Officer of Privy Council.*

Substitutes for Indian Ink.—A substance much of the same nature and applicable to the same purposes as Indian ink may be formed in the following manner:—Take of isinglass three ounces: make it into a size by dissolving over the fire in six ounces of soft water. Take then Spanish liquorice one ounce, dissolve it in two ounces of soft water over the fire in another vessel, then grind up on a slab with a heavy muller one ounce of ivory black with the Spanish liquorice mixture. Then add the same to the isinglass size while hot, and stir well together till thoroughly incorporated. Evaporate away the water, and then cast the remaining composition into a leaden mould slightly oiled, or make it up in any other convenient way. This composition will be found quite as good as the genuine article. The isinglass size mixed with the colours work well with the brush. The liquorice renders it easily dissolveable, on the rubbing up, with water, to which the isinglass alone would be somewhat reluctant; it also prevents it cracking and peeling off from the ground on which it is laid. A good Indian ink may be made from the fine soot from the flame of a lamp or candle received and collected by holding a plate over it. Mix this with the size of parchment, and it will be found to give a good deep colour. Burnt rice has been by some considered a principal ingredient in the genuine Indian ink, with the addition of perfumes or other substances not essential to its qualities as an ink.—*British Journal of Photography.*

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements* and *Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

Vol. IX. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol X. commenced on July 2, 1864, and will be complete in 26 numbers.

A. H. A.—Received. Answer next week.

J. Morgan.—There is a large sale for the article. We do not know the market price.

Received.—Dr. Machattie; A. R.

Books Received.—Watt's Dictionary of Chemistry, Part XX.; The Ophthalmic Review, No. 3; The Mining and Smelting Magazine for October; Storer's Dictionary of Solubilities, Part III., completing the work; Miller's Elements of Chemistry, Part II., Inorganic Chemistry

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Chemical Examination of a Hot Spring containing Cæsium and Lithium in Wheal Clifford, Cornwall, by W. A. Miller, *M.D., Treas. R.S., Prof. Chemistry King's Coll., London.*[*]

In the course of conversation with Sir C. Lyell a few months ago, he mentioned to me the existence of a remarkable hot spring in one of the Cornish mines, occurring at a great depth below the surface, and of which no detailed chemical examination had been published. The interest attending such an examination was obvious, and it was arranged that a supply of the water should be forwarded to me for analysis. Mr. Horton Davey, of Redruth, at the request of Sir C. Lyell, kindly superintended the collection of the water. Part of this water, which was to be examined for its gaseous constituents, was received into glass Winchester quart bottles, filled by immersion in the spring to within a very short distance of the neck, the stoppers inserted and securely fastened.

Wheal Clifford is a copper mine near Redruth, in Cornwall, situated some miles from the coast. The lode runs east and west in a fissure of the clay-slate, and consists of a porous copper pyrites; the spring comes up in the lode itself, one wall of which, where the spring breaks out, is formed by a dyke of elvan or granitic porphyry. This spring has been roughly estimated by Mr. Davey to yield 150 gallons a minute. It issues at a temperature observed by Professor W. Smyth of 122° or even of 125°, as stated by Mr. Davey from observation at a somewhat deeper point.[†] The temperature in that part of the mine from which the water was taken was 110°, the sample of water being collected in the 230 fathom level, or about 220 fathoms below the mean level of the sea.

The following are the results of the analysis:—

Specific gravity at 60° F.	1007·0
1 Imperial gallon contains of gases at 30 inches bar. and 60° F.	cub. in. 8·91
Consisting of	
Carbonic acid . . . 1·89	
Oxygen . . . . 1·72	
Nitrogen . . . . 5·30	
Ratio of oxygen to nitrogen . . 1 : 3	
1 Imperial gallon contains of fixed salts by evaporation	Grains. 646·1
Consisting of	
Chloride of lithium	26·05
Chloride of potassium with a little chloride of cæsium	14·84
Chloride of sodium	363·61
Chloride of magnesium	8·86
Chloride of calcium	216·17
Sulphate of calcium	12·27
Silica	3·65
Oxides of iron, manganese, and aluminum	traces
	645·45

The total saline contents was ascertained by evaporating a tenth of a gallon with carbonate of sodium. The determination of each constituent was effected in nearly every case upon 0·1 gallon of the water, and the mean of two determinations was taken. The chlorine was ascertained by precipitation with fine silver, as in the ordinary method for humid assay. It was necessary to precipitate the magnesia in the form of hydrate by the addition of hydrate of baryta to the water after it had been concentrated by evaporation, in order to prevent the lithia from going down with it as phosphate, which occurred when it was attempted to separate the magnesia in the usual manner. The precipitated hydrate of magnesia was then redissolved in acid, and its amount determined as usual in the form of pyrophosphate.

The amount of lithium was ascertained by evaporating the filtrate from the hydrate of magnesia after the addition of hydrate of baryta, separating lime and excess of baryta by the addition of oxalate of ammonium, evaporating to dryness, and expelling the ammoniacal salts by a moderate but prolonged heat. The residue was moistened with hydrochloric acid, and again dried at about 350° F.

The lithium was then determined as phosphate by Mayer's plan as follows:—The alkaline chlorides were dissolved in a small quantity of water, mixed with a slight excess of rhombic phosphate of sodium, and evaporated slowly to dryness, maintaining a very feebly alkaline reaction by the addition of small quantities of a weak solution of hydrate of soda. The dry residue was then digested with a small quantity of water, to which an equal bulk of strong solution of ammonia was subsequently added, and the mixture allowed to stand for twelve hours. The crystalline precipitate of phosphate of lithium was collected on a small filter and washed with a rather strong solution of ammonia. 0·2 gallon of the original water gave 4·74 grains of the phosphate of lithium ($L_3P\Theta_4$).

This result was checked by determining the amount of sulphuric acid and potassium in a known weight of the mixed sulphates of sodium, potassium, and lithium. The result of this indirect method indicated 27·5 grains of chloride of lithium per gallon.

The occurrence of so large an amount of lithium, being eight or ten times as much per gallon as has been found in any spring hitherto analysed, invests this water with unusual interest and importance; and as lithium has been employed medicinally to an extent hitherto limited by its high price, it may prove of great commercial value. No less a quantity than 800 lbs. of the chloride of lithium would be furnished every twenty-four hours by this spring on the supposition that it contains 26 grains of the chloride per gallon, and yields 150 gallons per minute. The presence of cæsium in quantity by no means insignificant also adds to the importance of the spring, as no doubt the mother liquor might be employed as a source of cæsium after the separation of lithium.

The following is an outline of a process by which the salts of these two alkaline metals might be extracted:—

The water must first be raised without dilution to the surface. It must then be reduced by evaporation to about a twelfth of its bulk, or to a specific gravity of 1·080. As the water does not deposit any sensible amount of fur when boiled down, this preliminary concentration might be effected at little cost in the boiler of a steam-engine to save fuel.

To the concentrated and boiling liquid a strong solution of carbonate of sodium must next be added gradually so long as it produces a precipitate. A copious granular deposit, consisting chiefly of the carbonate of calcium, is thrown down, carrying with it a sensible amount of carbonate of lithium.

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[*] Read at the meeting of the British Association at Bath, and communicated by the author.

[†] Professor Smyth communicated to the meeting at Bath some details respecting the geological features of this spring, to which for further particulars the reader is referred.—*Mining and Smelting Journal*, October, 1864, p. 193.

The clear liquid is decanted; it retains alkaline chlorides only. It must be rendered just acidulous to litmus by hydrochloric acid, and evaporated down; chloride of sodium will crystallise out; and on adding carbonate of sodium to the concentrated liquor impure carbonate of lithium will be deposited.

The mother liquors may then be treated for cæsium. But as the amount of its salt is very small, compared with that of the other alkalies, no means appears at present to be applicable but that described by Bunsen and Kirchhoff (*Phil. Mag.*, November, 1861)—viz, the addition of perchloride of platinum, with a view to the formation of the sparingly soluble double salts of cæsium and platinum ($2CsCl,PtCl_4$), and subsequent removal of the potassium compound, which goes down with the cæsium salt, by repeated boilings with small quantities of water.

It was by following this method and examining the washed platinum salt in the spectroscope that cæsium was ascertained to exist in this water. No evidence of the presence of rubidium was thus procured, though possibly, had I been able to operate on a still larger quantity of water, I might have been enabled to detect it.

On the Indirect Determination of Potash and Soda, by P. Collier, *B.A., Assistant in the Sheffield Laboratory, Yale College.*

The method customarily employed in estimating potash and soda—viz., by the precipitation of the former as platino-chloride of potassium, and reckoning soda from the loss—though sufficiently accurate in patient and skilful hands, is yet open to many sources of error, and at the best is exceedingly tedious and troublesome.

The indirect method does not yet appear to possess the confidence of chemists—at least, it is rarely mentioned in published investigations. I have, therefore, at the suggestion of Professor Johnson, made a number of experiments to ascertain the limits of error in this process.

The volumetric estimation of chlorine as perfected by Mohr offers by far the best basis for an indirect determination of the alkalies. It is, in fact, requisite, in employing the usual direct method, to procure the alkalies in the condition of pure chlorides before precipitation.

When the alkali chlorides are obtained free from all foreign matters, it is but the work of a few moments to ascertain their contents of chlorine.

The silver solution used for this purpose is best prepared by weighing off in a porcelain crucible about 4·8 grm. of clear crystallised nitrate of silver, fusing it at the lowest possible heat, and then ascertaining its weight accurately. After fusion it should weigh a *little more* than 4·7933 grm., the quantity that, contained in a litre of water, gives a solution of which 1 c.c. = ·001 grm. of chlorine. The fused salt is dissolved in a little warm water, the solution brought into a litre flask and filled to the mark, observing the usual precautions as to temperature, &c. When thus adjusted, add to the contents of the flask, from a burette, enough water to bring the excess of nitrate of silver above 4·7933 grm. to the requisite dilution. In this way it is easy, with a burette and litre flask, to make a perfectly accurate standard solution, while this would be hardly possible should the operator weigh off less than 4·7933 grm. of nitrate of silver.

This solution, which may be preserved in a well-corked bottle indefinitely, without change, is next tested by means of a solution of pure chloride of sodium or chloride of ammonium; a quantity, say about 2 grains, of one of these salts being dissolved in a litre of water and 10 c.c. of the liquid taken for the comparison. The solution being ready, the estimation of chlorine is conducted as described by Messrs. Mohr, Fresenius, Sutton, and others, chromate of potash being employed to indicate the completion of the reaction. The use of Erdmann's float in a burette (which may hold 70 c.c.) graduated to fifths ensures the needful accuracy of reading. In my determinations $\frac{2}{10}$ths c.c. of silver solution were deducted as the excess needed to produce a visible quantity of chromate of silver.

The appended table gives the results I obtained in analyses of the chlorides of potassium and sodium. The salts were perfectly pure, and the quantities were weighed out in each case. In order to test the method thoroughly, I have varied the proportions of the mixtures from one extreme to the other.

Summary of Volumetric Chlorine Determinations.

	KCl taken.	NaCl taken.	Cl found.	KCl calculated.	NaCl calculated.	Cl calculated.
1st analysis	·0582	..	·02780	·05725	·00095	·02768
2nd ,,	·1668	..	·07940	·16617	·00063	·07932
3rd ,,	·1507	..	·07168	·15056	·00014	·07167
4th ,,		·0590	·03600	..	·06062	·03579
5th ,,	·0782	·0317	·05640	·07811	·03159	·05642
6th ,,	·0305	·0179	·03750	·03044	·03796	·03750
7th ,,	·0455	·0169	·03200	·04464	·01776	·03189
8th ,,	·0166	·0480	·01720	·01514	·04946	·03702
9th ,,	·0530	·0429	·05120	·05319	·04272	·05123
10th ,,	·0431	·0820	·07027	·04282	·08228	·07024
11th ,,	·0992	·0182	·05820	·09929	·01811	·05821
12th ,,	·0967	·0102	·05217	·09669	·01021	·05217
13th ,,	·0101	·1029	·06718	·01019	·10260	·06723
14th ,,	·1284	·0067	·06512	·12841	·00669	·06512
15th ,,	·0065	·1100	·06990	·00584	·11066	·06982

It may be seen from the above list of analyses, which includes all the determinations I have made from first to last, for the purposes of this paper, that in no case does the difference between the quantities taken and found of either alkali chloride exceed two milligrammes, and in most instances it is less than one milligramme. The correspondence between the amounts of chlorine as taken and found, is, of course, still more near. The error that appears in the estimation of the chlorides would be considerably reduced, if, as usually happens, they were calculated as oxides.

Here follow the formulæ which I have employed for calculating the quantities of NaCl and KCl, or of NaO and KO, contained in or corresponding to any mixture of alkali chlorides whose total weight and amount of chlorine are known.

W = weight of mixed chloride.
C = weight of chlorine.

$$NaCl = C + 7{\cdot}6311 - W + 3{\cdot}6288.$$
$$KCl = W + 4{\cdot}6288 - C + 7{\cdot}6311.$$
$$NaO = C + 4{\cdot}0466 - W + 1{\cdot}9243.$$
$$KO = W + 2{\cdot}9243 - C + 4{\cdot}8210.$$

The results I have obtained thus demonstrate that the indirect method is in all cases equal in accuracy to the ordinary separation, while in the matter of convenience and economy of time there is no comparison between them.—*American Journal of Science*, vol. xxxvii., p. 344.

On the Determination of Nitrogen by Weight, by Wolcott Gibbs, *M.D., Rumford Professor in Harvard University.*

Bunsen* has given a method of analysing nitrates and nitrites which renders it possible to determine all the constituents of the salt in a single analysis. This method consists essentially in igniting the salt in an atmosphere of nitrogen gas, absorbing the oxygen evolved by metallic copper, and collecting the water in a chloride of calcium tube. The nitrogen in the salt is given by the loss of weight in the apparatus.

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* *Ann. der Chemie und Pharmacie*, lxxii, 42.

In those analyses of nitrates or nitrites in which it is only desired to determine the nitrogen, the following process may be employed with advantage :—

A hard glass tube about six inches in length is sealed at one end, and its volume determined by filling it with mercury and pouring this into a graduated vessel. The tube is to be carefully dried and weighed with a good cork; it is then to be filled with finely divided metallic copper, prepared by the reduction of the oxide, so as to enable the operator to judge of the quantity necessary. The salt to be analysed is then weighed and mixed with the metallic copper, either in a mortar or with a mixing wire in the tube, and the tube with its contents and cork is again weighed. The weight of the copper employed is thus known, and its volume may then be found by dividing this weight by the density of metallic copper. A weighed chloride of calcium tube is then adjusted as in organic analysis, and the combustion tube is heated in the usual manner. When the combustion is finished, the open end of the chloride of calcium tube is sealed with the blowpipe flame, and the combustion tube allowed to become perfectly cold. The chloride tube is then removed and weighed, and the combustion tube also weighed with its cork. The increasing weight of the chloride of calcium tube gives the amount of moisture in the copper and the water in the salt analysed. The loss of weight in the combustion tube gives the nitrogen in the salt after correction for the oxygen in the tube, for the moisture in the copper, and for the water in the salt. The correction for the oxygen in the combustion absorbed by the copper is easily found, with a sufficiently close approximation, by subtracting the volume of the copper from that of the tube, finding the weight of the residual air, taking one-fifth of this as oxygen, and considering the whole of this oxygen as absorbed by the copper. A piece of asbestos may be placed between the copper and the cork with advantage; but this renders an additional correction necessary.

Two analyses were executed by this method. In the first a sample of pure saltpetre gave 13·86 per cent. nitrogen; the formula KO,NO_5 requires 13·86 per cent. In the second, a specimen of the commercial salt gave 13·7 per cent. nitrogen, while the same salt analysed by Simpson's method, in which the volume of the nitrogen is determined, also gave 13·7 per cent. The whole analysis, with the weighings, may easily be executed in an hour and a half by a single person. It is easy to see that this method applies to all inorganic nitrates and nitrites, whether hydrous or anhydrous, but that it cannot be employed in the case of organic or ammoniacal salts. In the analysis of inorganic nitrates or nitrites by Simpson's method, it is not necessary to use oxide of mercury to prevent the formation of deutoxide of nitrogen. In all such cases it will be found sufficient to mix the salt with pure metallic copper. In this manner the dimensions of the combustion tube may be greatly diminished. I have also found it advantageous to pump out the air from the combustion tube by a small hand air-pump before disengaging carbonic acid from the carbonate of manganese. By alternately pumping and filling the tube with carbonic acid, the air may be completely expelled before the combustion commences. It is also better to draw the tube out before a Bunsen's gas-blast, as it is difficult to make a cork and india-rubber connector perfectly tight. With a little practice the drawing out is easily effected even with the hardest combustion tubes. When many nitrogen determinations are made, it will be found convenient to employ printed forms for logarithmic calculations, the logarithmic constants of reduction being printed upon the form itself in their proper places.—*American Journal of Science*, vol. xxxvii. p. 350.

A Suggestion on the Detection of Poisons by Dialysis by Dr. A. T. Machattie, *F.C.S., &c., Glasgow.*[*]

The general importance of the process of dialysis, for the separation of crystalloid substances from complex organic mixtures, is so well known as to render it unnecessary for me to refer to it at this time. The suggestion which I am about to lay before you has reference principally to the difficulty of detecting poisons when mixed with the heterogeneous contents of the stomach or intestines of the animals to which they may have been administered; and, unquestionably, one of the most important applications of dialysis consists in the detection of poisons by its means in the animal system after death.

Experiments have been already made with the ordinary hoop dialyser, in which parchment paper acts as the membrane or septum to such an extent as may satisfy all of the simplicity and value of the process of dialysis, both in the detection of poisons and in investigations on physiological chemistry; but, when experimenting lately with a common dialyser, it occurred to me that in some cases it might be of advantage to employ the animal organ itself as the dialyser, using the coats of the stomach or intestines as the membrane or septum, and in this way avoid interference with the organs themselves until they had been subjected to investigation. This can the more readily be done, since the exterior of the stomach of animals is seldom coated with any appreciable amount of fatty matter, and, therefore, the whole preparation necessary seems to be to thoroughly wash the exterior of the stomach or intestines to be examined; for thereafter the organ may be at once exposed to the external action of pure water, as in the commonly pursued methods of dialysis. This manner of separating a poison need not entirely prevent the previous examination of the interior lining of the stomach, provided that the opening be made so as to enable the stomach to be afterwards suspended in water without mechanical leakage. The intestines of an animal supposed to be poisoned seldom require to be opened throughout their entire length, and, accordingly, a portion of them left unopened may be tied firmly at each end, washed carefully, and exposed to the external action of water for twenty-four hours, or longer if necessary, in the usual way.

I regret that want of time has as yet prevented me from testing this process thoroughly, to see how far it may be considered any improvement on the common method of working, but certain preliminary experiments which were made to determine the practicability of the method now suggested may be mentioned.

(1.) Into the reticulum or honeycomb bag of a sheep were placed three grains of arsenious acid, partly dissolved, but principally suspended, in one ounce of water. The organ was then carefully washed with distilled water, and afterwards almost completely immersed in ten ounces of water, contained in a glass beaker. At the end of twenty-four hours the liquid in the beaker was greenish in tint, due to the colouring matter of the grass with which the various stomachs of the sheep were nearly full when the animal was killed. One half of the liquid, or about five ounces, was treated with hydrochloric acid, which caused a precipitation of white flocculent matter. The acid liquid was filtered from this precipitate, and then saturated with hydrosulphuric acid, when a slight precipitate of tersulphide of arsenic was obtained. Another portion, tested by Reinsch's process, gave abundant evidence of the presence of arsenic. No evaporation of the external liquid was required in either instance.

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[*] Read at the meeting of the British Association at Bath.

(2.) Into a portion of the duodenum of the same sheep, one-half of a grain of arsenious acid was placed, dissolved and suspended in water, as in the preceding experiment. This part of the duodenum, after being washed, was tied at each end, and suspended in eight ounces of water, in such a manner as to keep the tied ends entirely out of the water, and so prevent the contents from escaping by any opening that might still exist. The liquid became greenish, as in the first case, and after twenty-four hours yielded arsenic by Reinsch's process; but no appreciable precipitate was obtained by treating the liquid with hydrochloric and hydrosulphuric acids.

(3.) Three grains of strychnine dissolved in one ounce of water, with the addition of a few drops of hydrochloric acid, were added to the contents of the omasum or manyplies of the sheep, and when suspended in water for twenty-four hours, as before, strychnine was detected in the external liquid. In this instance, however, it was necessary to evaporate the liquid; and as the presence of organic matter prevented the application of the colour tests for the alkaloid, ether was required to separate the strychnine in a state pure enough to be recognised. Bichromate of potash and sulphuric acid gave evidence of the strychnine by the characteristic violet tint, and the bitter taste was easily observed.

The above experiments are not adduced as in any sense conclusive of the value of the suggestion now made for the detection of poisons, but they show that arsenic and strychnine pass readily through the walls of the stomach and intestines of a dead sheep; and considering that the structure of the stomach and intestines of the higher animals is very nearly alike in all, and that so many of the commonly used poisons are crystalline like the two selected for experiment, it may safely be assumed that other crystalline poisons may be detected in other animals in a manner precisely similar to that described above.

The quantity of poison used in the above experiments is large—larger than what may be expected to occur in the body of many poisoned animals; and it is therefore possible that with minute traces of poison this process of detection might fail. On this head I can say little or nothing as yet, having had no opportunity of pursuing the investigation to any length, but I hope to be able soon to vary the experiments, and satisfy myself whether the process can be considered an improvement on those already known, or even advisable in practice at all. One remark may be made on the time of exposure. The only limit in this respect appears to be the length of time before putrefaction takes place. Twenty-four hours is probably the minimum which should be trusted, and the maximum time will depend on the temperature and season, because putrefaction will more or less rapidly destroy the dialysing membrane.

In conclusion, it appears to me that many problems in physiological chemistry might be better elucidated by the process just suggested than by using an ordinary hoop dialyser. In discovering, for example, what portion of the contents of the stomach or intestines of an animal pass through the walls of the organs with the greatest rapidity, it would surely be better to take the stomach or other organ exactly in the condition in which we find it in the animal, and without unnecessary mixture of, or interference with, its contents, and also without any exposure to air, which must produce some change, treat it with water externally at once, and thus prevent the influencing of the results by unnatural treatment, which cannot be avoided in the usual process.

A Physical Analysis of the Human Breath.

In the August number of the *Philosophical Magazine* is a paper on "A Physical Analysis of the Human Breath," by Mr. W. F. Barrett, assistant in the Physical Laboratory of the Royal Institution. The experiments were made by the desire, and under the direction, of Professor Tyndall. The mode of analysis is founded upon the calorific absorption exerted by the carbonic acid contained in breath, the apparatus used by Mr. Barrett being mainly the same as that employed by Professor Tyndall in his researches on the absorption of heat by gaseous matter.

With ordinary sources of heat carbonic acid is probably the most feeble absorbent among the compound gases; but in a memoir which Professor Tyndall read before the Royal Society in March last it was shown that when a carbonic oxide flame is used as a source of heat, carbonic acid instantly reverses its position, and exceeds all other gases in its heat-absorbing power. Mr. Barrett has applied this fact to the determination of carbonic acid in those cases where small quantities of that gas are present. The paper he has published shows the result of his experiments upon air and breath.

The method of experiment is as follows:—A small flame of carbonic oxide is caused to burn regularly within a glass globe. The globe on one side has an aperture opposite the flame; this allows the radiation to pass unchanged into a brass experimental tube, which is mounted horizontally in front of the lamp. This tube is 49·4 inches long, and has its ends stopped air-tight by plates of rock-salt; it is also connected with an air-pump, so that it can be exhausted at pleasure.

The radiation from the flame after passing through the experimental tube, which has been well exhausted, falls on a thermo-electric pile, deflecting the needle of an attached and most delicate galvanometer. This deflection is neutralised by placing before the opposite face of the pile a cube containing water kept boiling; and by the careful adjustment of a double metal screen the needle is caused to stand precisely at zero.

If an absorbent gas be now admitted into the tube, the balance is destroyed, and, from the predominance of the cube source, the absorption by the gas in the tube can be calculated. If the gas has no energy as an absorbent the needle remains at zero.

Pure dry air tried in this manner showed no absorption, but common air gave an absorption of 15 per cent. of the total radiation; air deprived of its aqueous vapour, but retaining its carbonic acid, gave 13·8 per cent. absorption; whilst air bereft of its carbonic acid, but retaining its aqueous vapour, gave only 6·4 per cent.

Variations in the amount of carbonic acid present in the air can be detected by this method, as is shown by comparing air from Brighton downs with air from the laboratory, the absorption in the latter case being upwards of 4 per cent. greater than that in the former.

These experiments led the way to the subject of the paper. Four bags are filled at different periods with air from the lungs. After the breath has been dried by passing over sulphuric acid, the absorption by each specimen is separately examined and compared with a chemical analysis made by Dr. Frankland. In each case increase in absorption is found to accompany increase in the amount of carbonic acid. Upwards of 50 per cent. of the whole radiation from the flame was cut off by filling the tube with air from the lungs, the small amount of carbonic acid present being the only agent that intercepts so large a quantity of heat.

A series of experiments are then recorded, which have for their object the exact quantitative measurement, by physical means, of the carbonic acid contained in the human breath.

This is finally accomplished in the following manner: —A certain amount, about ⅔rds of an atmosphere, of pure air is caused to enter the experimental tube; the air by itself gives no absorption. One inch, or the thirtieth of an atmosphere, of dry carbonic acid is then added to the air; the needle of the galvanometer now shows a marked deflection, which is carefully noted. The amount of carbonic acid in the tube is then increased by, say, a tenth of an inch, the needle shows a higher deflection; this is again noted. The quantity of carbonic acid is thus gradually augmented, until its absorption—found from the deflection—is equal to the previously determined absorption by one of the specimens of breath. When this occurs, the whole amount of carbonic acid admitted into the tube is accurately read off from the barometer guage attached to the air-pump. The breath having been tried at a uniform pressure of an atmosphere, a simple proportion gives the percentage of carbonic acid in it, supposing, as is the case, this gas to be the only heat-absorbing agent in the breath.

It will be noticed that the carbonic acid in the tube is there in the same condition as it is found in breath—namely, mixed with a large quantity of air. The presence of this air was found to be important, for although by itself the air is inert as an absorbent, yet twenty inches of it raised the absorption by the carbonic acid about 4 per cent. The cause of this is very interesting. The author believes that a portion of the carbonic acid gas when admitted into the tube alone, condenses on the interior and polished surface of the brass experimental tube, "the entrance of dry air removes the film, and consequently throws a larger amount of gas in the path of the rays from the source."

The author then sums up his various experiments, and gives, in Table xiii., a succinct view of the absorption by a mixture of carbonic acid and pure air, the tension of the former ranging from 0·5 of an inch to 2 inches. From this table is calculated the percentage of carbonic acid in eight different specimens of human breath, the absorption by thirty inches of each specimen having of course been already determined. Dr. Frankland analysed by the usual chemical method four of these specimens, and in the next table, which we subjoin, the author compares in the last two columns the percentage he has obtained with that found by Dr. Frankland. The other figures in the table will explain themselves.

Bag No.	Absorption per 100: By 30 in. of breath.	Absorption per 100: By pure carbonic acid and dry air.	Tension of CO_2 in parts of an inch.	Percentage of carbonic acid found: By physical analysis.	Percentage of carbonic acid found: By chemical analysis.
1 .	50·6	50·7	1·2	4·00	4·311
2 .	52·8	52·6	1·4	4·66	4·556
3 .	53·7	53·7	1·55	5·16	4·061
4 .	54·0	54·0	1·6	5·33	5·212
5 .	50·0	50·0	1·15	3·83	
6 .	52·7	52·6	1·4	4·66	
7 .	50·0	50·0	1·15	3·83	
8 .	52·1	52·0	1·3	4·33	

Here in three cases is a very close agreement between the physical and chemical analysis, close for so novel a method. In the case of bag No. 3 the difference is somewhat great. The cause of this is, however, satisfactorily explained by the author.

The table shows that the principle upon which the determinations rest is certainly correct and also practical. Repeated experiments, bringing greater experience, would probably cause the differences between the two modes of analysis entirely to disappear.

But, in the end, what advantages does the physical method adduce for its support? The facts revealed by the numerous tables leave no doubt on our mind that it is evidently a more delicate test of the existence of carbonic acid than the present chemical means. As such it will be of service in many cases where chemical analysis would fail. If a simple and ready mode of making a physical analysis of breath can be devised, this new method will undoubtedly be most useful in hospitals and elsewhere.

PHYSICAL SCIENCE.

On the Spectra of some of the Heavenly Bodies, by Dr. Miller *and Mr.* Huggins.*

A portion of this paper—that relating to the spectra of the planets—has already appeared in the Chemical News, but the concluding part made known one of the most interesting discoveries of modern times. It related to the spectra of nebulæ, the observations on which were said to have been conducted solely by Mr. Huggins. The nebulæ observed were chiefly those denominated planetary, because of their close resemblance to planetary discs. They have hitherto been regarded as probably clusters of stars, which, by mutual proximity and vast distance, are reduced to the form of discs. In the observation of these Mr. Huggins had many difficulties to overcome.

It was not thought that the light of these bodies would be sufficient to produce any spectrum at all; nor would it have done so had their construction been that which has been usually assigned to them. But what was the surprise of the observer to behold, not a continuous spectrum such as that which proceeds from a solid body interspersed with dark lines due to atmospheric absorption, but a spectrum consisting of a few bright lines such as that which proceeds from an intensely-heated gas. It was, indeed, the smallness in number of these component lines that enabled any success to be obtained; and the result from one of these nebulæ revealed the astounding fact that it was probably composed of hydrogen and nitrogen without any solid nucleus whatever. But what is the origin of this high temperature, since we are sure, from the conservation of energy, that some other form of motion must be destroyed in order to produce the luminosity? The origin of the light of the heavenly bodies thus becomes more perplexing than ever, and seems to point to some law regarding which we are yet in the dark.

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* Abstract of paper read before the British Association.

PHARMACY, TOXICOLOGY, &c.

On the Medicinal Muds of the Island of Ischia (Bay of Naples),[*] *by Dr.* T. L. PHIPSON, *F.C.S., &c.*

Two specimens of these muds were forwarded not long ago to my laboratory in London, in order to be analysed. I believe they were brought to England by Colonel Stuart Wortley. Invalids visiting Ischia plunge their arms, legs, or entire bodies into these muds for various diseases, more particularly for scrofula and rheumatism; they are supposed to have a peculiar healing power. It was, therefore, interesting for me to submit them to a careful examination.

One of the bottles containing the specimens was ticketed *Fango del Gurgitello*, the other *Fango dell Arita*. They differ very much in appearance and in smell, though they are essentially the same in composition, being formed of the volcanic or feldspathic grains resulting from the destruction of the rocks of the district. The whole constitutes a volcanic sand, rendered muddy by water, and a certain amount of vegetable *débris*. The grains are composed of lava, green feldspar, ryacolite in beautiful glassy grains, augite, quartz, mica, and here and there a few fragments of marble, &c. My analysis of these muds gives them the following composition:—

Fango del Gurgitello.

Greenish grey; no smell; insipid; sandy, with little mud. Deposits sulphur on a plate of silver in twenty-four hours.

Water	30·00
Organic matter	4·00
Oxide of iron	1·40
Carbonate of lime	1·20
Bromine and iodine	none
Sulphur	traces
Volcanic sand as above described	63·40
	100·00

Fango dell Arita.

Black; smell of putrid algæ and sulphuretted hydrogen. Gives PbS on paper imbibed with acetate of lead when heated.

Water	42·85
Organic matter	4·05
Black sulphide of iron	1·36
Oxide of iron	2·00
Carbonate of lime	2·60
Bromine and iodine	none
Sulphur	notable quantity.
Volcanic sand	47·14
	100·00

The Italian bottles in which these specimens of the Ischia muds were sent to me, though corked with large glass stoppers, do not close hermetically, and I have no doubt that the water of these muds, in its natural state, is strongly impregnated with sulphuretted hydrogen, which has almost entirely escaped during the journey. It is doubtless to the presence of sulphur that the muds owe some of the medicinal properties ascribed to them, as it is the only active substance present in them. The black colour of the mud *dell Arita* is owing to a layer of black sulphide of iron formed by the sulphuretted hydrogen upon the grains of green feldspar, which it envelopes completely; when the mud is exposed to the air for some time the black sulphide is gradually oxidised, and the grains assume their original green colour. In this manner the *fango dell Arita* becomes similar to the *fango del Gurgitella*.

It is remarkable that sulphuretted hydrogen—like carbonic and sulphurous acids—attacks the *iron oxide* of the feldspar rocks in preference to the alkalies, which are not attacked at all, for the glassy grains of ryacolite have undergone no decomposition whatever. Diluted hydrochloric acid dissolves this black sulphide of iron formed on the surface of the green grains, with evolution of sulphuretted hydrogen.

No bromine or iodine could be detected in either of the sands, but by passing a magnet through some of the Arita mud, a number of brilliant black grains adhered to it, and were proved to be magnetic oxide.

The water separated by filtration from the sand, &c., merely gave indications of lime, sulphates, chlorides, &c., and did not differ from ordinary river water, except by the presence of a small proportion of free sulphuretted hydrogen, which, in that of the fango dell Arita, only amounted to $\frac{6}{100000}$ths; but, as stated already, I believe the greater portion of this gas had escaped during the journey.

The curious custom of plunging the body into muds of this kind as a means of restoring health is not confined to Ischia; I have lately mentioned in the *Geological Magazine* a similar custom prevailing on the shores of the salt lake Balta Alba in the Danubian provinces; I have also heard of a similar practice being carried out in the South of England.

The beneficial results that are said to follow this treatment are probably owing as much to the cleansing and stimulating effect produced by the friction of the grains of sand upon the skin, as to the presence of sulphur in the muds.

On the Extraction and Preservation of Aromata, by C. R. C. TICHBORNE, *F.C.S., Chemist to the Apothecaries' Hall of Ireland*[*].

OBSERVING the preservative powers of glycerine for vegetable substances, the author packed different kinds of scented flowers in jars, and covered them with glycerine. In this way he had kept some for two years. If flowers, &c., so preserved be pressed, it is found that the glycerine has absorbed all the volatile oil, and when diluted and distilled furnishes a water in all cases superior to that from flowers preserved by salt. If the odoriferous glycerine be diluted and agitated with oils or fat, ointments, &c., of excellent quality are produced. In all these cases the glycerine is recovered by mere evaporation of water from it. The delicate oils of orange, jasmine, heliotrope, &c., are best isolated by steeping the flowers in the glycerine, pressing, and again steeping more flowers, and so on; finally diluting with water and shaking with chloroform, which removes the oil. The low boiling point of the chloroform admits of its being separated from the oil by a temperature which does not injure the oil.

In the course of a discussion which followed the reading of the paper, Mr. D. Hanbury remarked that the objects of the author were divisible into two classes, firstly, the preparation of distilled waters, and secondly, that of the more delicate volatile oils. He feared that the cost of pure glycerine and the difficulty of recovering it would prove serious obstacles to such a process. For the second purpose that had been named, a better method was required than the system of *enfleurage*, now in use in the South of France, &c. His friend, Dr. De Vry, when travelling in Java, had extracted the delicate odoriferous principle of some species of jasmine, *Pandora odoratissima*, &c., and by the use of ether got minute quantities of butyraceous volatile oils. It would be an important desideratum if this method would answer in such cases, and he (Mr. H.) was satisfied that it well deserved more extended investigation.

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[*] Read before the British Association, 1864.

[*] Read at the meeting of the Pharmaceutical Conference.

Other speakers advocated the use of pickled elder flowers in the preparation of elder flower water.

On Commercial Carbonate of Bismuth, by Mr. C. Umney.*

Commercial carbonate of bismuth having been suspected to be contaminated by basic nitrate, the author had analysed six samples, and gave in his paper the numerical results. In one case no nitrate was present, and the other five contained but small and probably accidental quantities.

In preparing carbonate of bismuth, by precipitating a solution of the nitrate by an alkaline carbonate, carbonate of soda was preferable to that of potash, but carbonate of ammonia with subsequent ebullition yielded the purest precipitate.

On the Pharmaceutical Applications of Glycerine, by Mr. F. Baden Benger.*

In this paper a short history was given, and a *résumé* of its applications in pharmacy. The preparations known as "plasma," in which glycerine with starch is substituted for lard, as a basis of ointments, had been made the especial subject of experiment by the author. He had found *tous-les-mois* starch superior to any other in making the simple plasma. Fifty grains of *tous-les-mois* was to be rubbed with one ounce of glycerine, and the mixture heated to 240° for a few minutes or till it became translucent. He thought that plasma might replace lard in ointments having a tendency to become rancid, but its relatively great expense would preclude its general adoption. The glyceroles, or solutions of different substances in glycerine, were then noticed. A good "tincture of myrrh and borax" could be made by dissolving one part of borax in two of glycerine, and adding tincture of myrrh. As substitutes for syrup, the glyceroles did not appear to possess any superiority. Its use as an excipient in pill-making was strongly advocated.

On Commercial Phosphoric Acid, by R. Parkinson, *Ph.D.**

Twenty-eight samples had been examined with reference to their strength and freedom from impurity, the result as to strength being that three samples came up to the British Pharmacopœia strength, five more were about the London Pharmacopœia strength, while the remainder were of various shades of declension. Phosphate of ammonia was present in six samples, sulphuric acid in one, nitric acid only traces in any. The presence of ammonia was considered evidence that the samples containing it had been made from the glacial acid, which, commercially, is made by heating the phosphate of ammonia, the whole of the ammonia never being practically got rid of. One sample of German glacial contained 5 per cent. of ammonia, which is equal to 17½ per cent. of tribasic phosphate of ammonia. If a pure glacial acid could be readily obtained, commercially, that was suggested as the best and safest means of obtaining the dilute acid, and the combustion of phosphorus, with arrangements for the supply of air and collection of acid, was suggested as the best mode of obtaining such a pure glacial acid. Other plans for its preparation, which were detailed, had been tried, and found satisfactory.

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL MEETING.

Wednesday, October 5.

Mr. Sandford, *President, in the Chair.*

This was the first Pharmaceutical meeting of the session, and was, as usual, devoted to the distribution of the prizes obtained in the classes of the preceding session. On opening the business, the President expressed the pleasure he felt at the recommencement of the evening meetings. On these occasions the members met as a society for mutual improvement, and he hoped the present session would afford no less instruction than past sessions. There were many subjects waiting for discussion. The British Pharmacopœia—much as was said about it last session—was still unexhausted. It had been reported that a new edition would be issued, but he believed the report to be incorrect, and it was therefore necessary that the members should come to some understanding as to which Pharmacopœia should be in use. At the present time, a patient might have a prescription made up in one establishment with Infusion of Gentian P.B., and in another with the infusion made according to the London Pharmacopœia, and one or the other was sure to be accused of a mistake. The members, therefore, ought to come to an understanding as to which they would work by. The poison question was also a subject which deserved their serious attention. The members were aware that the Medical Officer of the Privy Council had made a Report to the Government, and other things tended to show that some legislative interference would be attempted in the next parliamentary session. The subject was confessedly a difficult one, but he thought the members would see the advisability of meeting the views of the public and of some in authority, who seemed to think it very easy to ensure the safe custody and sale of poisonous substances. He did not know whether or not it would be advisable to introduce a poison clause into the Pharmacy Bill the Society hoped to carry through next session; but, he repeated, something must be done to meet the public views. That druggists were not always to blame for deaths which had been ascribed to their carelessness, was well shown by a case which he believed was referred to in Dr. Taylor's Report. It was that of a man who bought four ounces of Epsom salts of one druggist, and half a pound of oxalic acid of another. He then emptied the Epsom salts from the papers, replaced them with oxalic acid, and then poisoned himself. The substitution was afterwards proved by the circumstance that some crystals of Epsom salts were found remaining in the folds of the paper, and thus the druggist was acquitted of blame, and the fact of suicide established. The case was suggestive, and showed what frauds druggists were open to. With regard to the immediate business of the evening, the President observed that it afforded him peculiar pleasure. It was always pleasant to be brought face to face with successful men, and, moreover, he thought it would show that the Society was working well, and had worked well.

Professor Redwood then presented his Report. He said that after performing a similar duty for twenty years, he found it difficult to find anything fresh to say. He must report the same good conduct and diligence on the part of the pupils, and with regard to their progress he must remark that the standard at these examinations had greatly advanced. Much more was expected of pupils now than used to be expected; the questions given out were much more difficult than they were twenty years ago. In accounting for diminished attendance in classes and the laboratory, it should be remembered that the Society had now for many years sent out numbers of qualified instructors, and that candidates came from them ready prepared to pass the examinations of the Society. On the whole the retrospect afforded him great satisfaction.

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* Read at the meetings of the Pharmaceutical Conference.

Professor Bentley and Dr. Attfield then presented their reports, and expressed the same satisfaction with the progress and good conduct of their classes. Each Professor read the prize questions, which we append:—

Chemistry and Pharmacy—Dr. Redwood.

1. What are the respective weights of a pint of each of the following liquids:—Rectified spirit, proof spirit, chloroform?

2. What is the meaning of the term "specific heat;" how is the specific heat of bodies determined; and what is the specific heat of olive oil as compared with water?

3. What is meant by the term "dialysis?" Describe the method of conducting the process to which this name is applied, and mention some of the results which have been obtained by it.

4. Describe the preparation and properties of phosphorus and phosphoric acid.

5. State the sources from which bromine is obtained, and describe the method of isolating it, and also its properties and atomic weight.

6. Name the body represented by the formula C_2NH, and describe its properties and tests.

7. Give the atomic formula for urea; describe the method of producing it artificially, and the nature of the change effected by the application of heat to it.

8. Describe the processes of the British Pharmacopœia for the preparation of emetic tartar and hydrochlorate of morphia.

Medal, Mr. Watts; Certificate of Honour, Mr. Bingley and Mr. Passmore; Certificate of Merit, Mr. Golding and Mr. Hemmingson.

Materia Medica and Botany—Professor Bentley.

1. Describe the physical and chemical characteristics of chlorophyll. State where it is found, the conditions favourable to its development, and the changes which it undergoes at the different seasons of the year.

2. Define the following:—Bulb, corm, rhizome, tuber, and tubercule. Mention the various substances of the Materia Medica which present illustrations of them respectively, and name the plants which yield them, and the natural orders to which they belong.

3. Define the following terms:—Parasite, epiphyte, serrate, ligule, cupule, involucre, panicle, hypogynous, syngenesious, isomerous, gynandrous, and tetradynamous.

4. What are the substances required for the support of plant-life; and in what manner are they taken up by plants?

5. Describe the physical and chemical characteristics of both colchicum corm and seeds, and state the time of the year in which they should be collected for use.

6. Mention the officinal plants of the British Pharmacopœia derived from the *Ranunculaceæ*. Mention the botanical and geographical sources of podophyllum rhizome, and describe its physical and chemical characteristics.

7. Describe the physical characteristics of croton seeds; state their botanical and geographical source, the manner in which croton oil is obtained, and the differences between East Indian croton oil and English Croton oil.

8. Give the essential characters of the following natural orders, and enumerate the officinal plants of the British Pharmacopœia which they respectively contain:—Cruciferæ, umbelliferæ, atropaceæ, polygonaceæ, iridaceæ, and melanthaceæ.

Medal, Mr. Watts; Certificate of Honour, Mr. Bingley and Mr. Passmore; Certificate of Merit, Mr. Hall, Mr. Hemmingson, and Mr. Squire.

Practical Chemistry—Dr. Attfield.

1. You are furnished with four unlabelled pharmacopœial preparations; analyse and name them.

[The preparations were—1. White precipitate; 2. Syrup of phosphate of iron; 3. Distilled water; 4. Dilute nitric acid.]

2. Examine the specimens of calomel, sulphur, sulphate of quinine, hydrochloric acid, and chloroform, supplied to you, and report on their quality.

[The calomel contained 1 per cent. of bichloride; the sulphur 37 per cent. of sulphate of lime; the quinine 10 per cent. of sulphate of quinidine; the hydrochloric acid was contaminated with arsenious acid; the chloroform was pure.]

3. The solutions marked A and B may contain any of the ordinary salts used in medicine; analyse them, and state the result.

[A. Disulphate of quinine; B. Perchloride of iron.]

4. The powder given to you is also a mixture of medicinal salts; examine it, and state its composition.

[Bitartrate of potash and oxalic acid.]

Medal, Mr. Watts; Certificate of Honour, Mr. H. W. Smith; Certificates of Merit, Mr. Goolden, Mr. Passmore, and Mr. Bingley.

The President then presented the Pereira Medal, the highest honour the Society offered, to Mr. Watts, and expressed his hope that Mr. Watts would meet with as much success in the active pursuits of life as he had met with in his career as a student.

Mr. Watts briefly returned thanks to the Professors on the part of the students.

The other prizes distributed were as follows:—Herbarium Prizes.—Medal, Mr Thorne; Certificate of Merit, Mr. Collyer. Senior Bell's Scholarship, Mr. Watts; Junior do.. Mr. Harris. Minor Examination Prize of Books, equal in value to 2*l*., Mr. J. Mayfield (Miller's "Chemistry").

Professor Balfour, of Edinburgh, then addressed a few words to the meeting expressing the pleasure he felt at being present on the occasion; and the satisfaction he and every one else must feel at the result of the examinations. These, he was glad to see, were of a decidedly practical character, as all examinations of the kind should be. The Edinburgh branch of the Society was pursuing a similar course with great success.

As the usual time to adjourn had not arrived, Dr. Attfield read a paper entitled "*Contributions to the History of Balsam of Peru*," a report of which we defer.

ACADEMY OF SCIENCES.

October 3.

The second part of a memoir by M. Kuhlmann "*On the Crystallogenic Force*" was read. It related to the crystallisation of metals, the formation of mineral concretions, geodes, and arborizations in marbles, agates, &c. Under the first of these divisions the author spoke of the molecular change which iron subjected to concussions undergoes, and the consequent danger to the axles of wheels. M. Kuhlmann asserts that boiler-plates undergo the same change from the concussions of ebullition, and hence a frequent source of explosions. He suggests the following simple way of *testing boiler-plates*:—Clean a few square inches from oxide, and polish it with a fine file. Then act on the surface with nitric acid for some minutes. If, after washing, any crystalline structure be revealed, M. Kuhlmann thinks it will be well to have the boiler tested by hydraulic pressure. There are one or two other practical points in the paper to which we shall return.

Another paper was, "*On the Spontaneous Decolorization of Tincture of Litmus*," by M. Meunier. The author thinks this is due to the action of microphytes.

Messrs. Churchill's Literary Announcements.—The Messrs. Churchill write to correct an error in our paragraph last week. The "Principles and Practice of Medical Jurisprudence," by Dr. Taylor, is an entirely new work, and not a new edition of the Manual. It is a separate and complete treatise on the subject, and will be illustrated with numerous woodcuts.

NOTICES OF BOOKS.

Treatment of Consumption; with Remarks upon the Properties and Uses of various Remedial Agents. By Matthew Corner, M.D. London: Hardwicke. 1864.

Letters on the Lungs, &c., &c. By Robert Hunter, M.D. With a Preface by J. J. Macgregor, M.D., &c. London: Mitchell and Co. 1864.

These books lie beyond our critical cognisance, but we regard them as hopeful signs of the times, notwithstanding the wide difference of opinion which exists between the two writers. Dr. Corner regards consumption as a disease allied to rheumatism, to be cured mainly by the administration of carbonate of soda. Dr. Hunter looks on the same disease as a purely local one, caused by imperfect oxygenation of the blood, and hence to be cured by the inhalation of oxygen, and other remedies applied topically in the same way. We shall leave the medical profession to decide as to the correctness of these views, and content ourselves with stating that readers may gather hope at least from the perusal of the books, and patients possibly benefit from the adoption of the remedies.

Dr. Corner's book contains some useful hints on diet, ventilation, and other hygienic measures, which may be attended to with great benefit. The letters of Dr. Hunter are written in a lively style, and intended for popular reading; and, considering the commonness and fatal nature of the diseases of which they treat, we have no doubt they will have a wide circulation.

A Companion to the British Pharmacopœia: comparing the Strength's of the Various Preparations with those of the London, Edinburgh, and Dublin, United States, and other Foreign Pharmacopœias: with Practical Hints on Prescribing. By Peter Squire, F.L.S. (Second Edition.) London: Churchill and Sons. 1864.

This new edition of Mr. Squire's successful book is so much enlarged and improved as to deserve a separate notice as a new work. In the first place, the size has been increased by forty-eight pages—almost a fourth of the original work—by the addition of new matter, and without disturbing the arrangement. The greater part of the new matter consists of formulæ "not officinal," for numerous preparations in common use, and so giving information of great value to chemists and druggists.

In our notice of the first edition we pointed out the distinctive characteristics of the book, and need not repeat them here; but one addition has been made which must not be passed over without commendation. A complete index has been added, which at the same time serves as a posological table, the dose being appended to the name of every internal remedy, whether officinal or not. We may suggest to Mr. Squire *en passant* that he might publish much of the new matter with an index for the first edition in a separate form for the convenience of the purchasers of that edition.

We have only to add that Mr. Squire has made the best book on the British Pharmacopœia much better and more useful.

Annalen der Chemie und Pharmacie. September, 1864.

This number of the *Annalen* contains a paper "*On the Bromine Compounds of Nicotin,*" by Dr. Carl Huber. Bromine acts on nicotine with great violence; but by operating carefully with solutions in alcohol or ether a variety of products are obtained. The author has determined the composition of some of these, and among them a red crystalline mass obtained by operating with etherial solutions of bromine and nicotine. This he found to have the composition $C_{10}H_{13}N_2Br_5$. From this compound, by treatment with potash or ammonia, *bromnicotin* $C_{13}H_{12}Br_2N_2$ is obtained. This body is a weak base, which precipitates most metallic oxides from these solutions, and forms crystallisable compounds with acid salts. The author also describes a compound of hydrobromic acid and bromnicotin. A short notice is also given of the iodine compounds of nicotin.

The next paper is by C. Oeser, "*On Pimento Oil.*" E. Dollfus, in a paper "*On Cetyle Compounds,*" describes the acetate, butyrate, and valerianate of cetyle, and also cetyl-aldehyd. A. Baeyer gives a continuation of his "*Researches on the Uric Acid Group.*" Tollens and Fittig communicate an interesting paper "*On the Synthesis of Hydrocarbons of the Benzole Series,*" and describe the methods of obtaining methyl-phenyl, ethyl-phenyl, and amyl-phenyl. Methyl-phenyl the authors consider identical with toluol. They combat some of the views expressed by Schorlemmer in his paper on alcohol radicals, and express their belief in the possibility of preparing all the radicals of the ethyl series from the benzol series.

A paper by Dr. Moldenhauer follows "*On the Substitution Products of Glycerinic Acid.*" From this acid he obtained iodopropionic acid, and from the latter he procured hydroacrylic and lactic acids. By the dry distillation of glycerinic acid the author procured pyrotartaric acid and pyrotartaric anhydride.

Dr. A. Beyer describes the composition and properties of "*Oxygummic Acid*" obtained by Reichardt in the reaction of oxide of copper and potash on sugar. He regards it a tribasic acid, having the formula $C_6H_8O_{16}$.

A short paper by O. Popp gives "*A Method of Separating Cerium from Lanthanum and Didymium,*" which we shall give at length. The same author describes a *peroxide* of nickel and of cobalt, which he obtains by treating a salt of the first metal with acetic acid, and then adding hypochlorite of soda. On boiling such a mixture the peroxide of nickel separates as a deep blue coloured powder. A similar solution in the case of cobalt requires the addition of an alkaline carbonate to precipitate the peroxide in the form of a dark greenish brown powder. In another paper Popp gives reasons for believing that wasium oxide, as described by Bahr, is a mixture of yttria and oxide of cerium. Delafontaine, in a short notice "*On Wasium,*" states his belief that wasium is identical with cerium. Kaemmerer, in another short paper, gives his reasons for believing that the acid he discovered and named *isomalic* is not identical with diglycolic acid, as is supposed by Friedel and by Heintz. The other papers in this Journal have already appeared either in abstract or at length in the Chemical News.

Journal für Praktische Chemie. September, 1864.

The number opens with a paper "*On the Quantitative Estimation of Fluorine in some Bohemian Minerals,*" by Kobell. Another follows by Dr. Zangerle, entitled "*Chemical Researches on the Mineral Waters of Tiefenbach.*" All the other papers of any interest have already been noticed in the Chemical News.

The American Journal of Science and Arts. September, 1864.

The chemical papers in this number of Silliman's Journal include a continuation of Mr. Sterry Hunt's "*Contributions to Lithology,*" in which he gives analyses of various Canadian rocks. Some "*Notes on the New Almaden Quicksilver Mines,*" by B. Silliman, jun., will be of interest to miners. The author shortly describes the simple process and apparatus employed in distilling the mercury which in San Francisco, it seems, sells for 75c. per lb., while in London and New York it only fetches from 40c. to 50c. per pound. The process is simple distillation from large brick furnaces, capable of holding 60,000 to 100,000 lbs. of the ore. The condensers are lofty, capacious chambers of masonry. Under the furnaces, which are built upon brick arches, are plates of iron, to prevent loss of mercury. Before this precaution was adopted, much of the metal was lost in the earth, and in a single year 2000 bottles were recovered from the foundations of two furnaces. Professor Norton continues his paper "*On Molecular Physics*," and in this part gives his theory of crystallisation, to which we may refer on another occasion. There are also some novel views on some of the phenomena of light, heat, and electricity. Mr. Carey Lea concludes his "*Notes on the Platinum Metals*," devoting this part to the "*Reactions of the Platinum Metals*," and giving "characteristic criteria for all those cases in which it has been considered most difficult to discriminate" between the metals. The paper is of great practical value, and we shall publish it entire. There are several other papers of great value on different branches of science, and the present number fully sustains the high character of the journal.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1362. Frederick Oldfield Ward, Hertford Street, Mayfair, Middlesex, "Improvements in the manufacture of chromic acid and chromates."—Petition recorded June 1, 1864.

2222. James Williams, Broad Quay, Bath, Somersetshire, "Improvements in apparatus connected with fermenting, charging, cleansing, or tunning vessels, casks, or vats."—Petition recorded September 12, 1864.

2230. Harold Potter, of Manchester, "Improvements in bleaching fibrous substances."—Petition recorded September 13, 1864.

2252. Alfred Vincent Nngent, Chancery Lane, Middlesex, "An improved mode of, and apparatus for, preventing incrustation in steam boilers."—A communication from George Tracy Parry, Philadelphia, U.S.A.

2256. Mannel Leopold Jonas Levater, Bath-street, Newgate-street, London, "Improvements in the manufacture of driving straps or belting, and of tubes of vulcanised india-rubber, and also in the manufacture of the helical coils of wire commonly inserted in vulcanised india-rubber tubes, also in desulphurising articles of vulcanised india-rubber."—Petitions recorded September 15, 1864.

2260. John Hawkins Simpson, Kilmeena, Ireland, "Improvements in printing by electricity for telegraphic and other purposes."—Petition recorded September 16, 1864.

2276. John Henry Jebnson, Lincoln's Inn Fields, Middlesex, "Improvements in artificial fuel."—A communication from Paul Baudet, Paris, France.

2278. Frederick Yates, Birmingham, Warwick, "Improvements in the manufacture of iron and steel."—A communication from Dr. Adolph Gurlt, of Bonn, Prussia.

2282. John Hamilton Burns, Glasgow, Lanark, N.B., "Improvements in the distillation of volatile minerals, vegetable and other organic matters."—Petitions recorded September 17, 1864.

2289. Augustus Figge, Kensal Green, Middlesex, "Improvements in the construction of safety-match and fusee boxes."

2294. Richard Archibald Brooman, Fleet Street, London, "Improvements in the manufacture of phosphuret of iron, phosphate of lime, and alkaline phosphates."—A communication from Edouard Aubertin, Paris, France.—Petitions recorded September 19, 1864.

2298. William Laurence, Cornwall Villas, Paddington, Middlesex, "Improvements in apparatus for mashing and for cooling worts and other liquids."

2310. Edmund Smith, Hamburg, Germany, "Improvements in wet gas meters."—Petitions recorded September 20, 1864.

2320. Edward Young, Onghtibridge, near Sheffield, Yorkshire, "Improvements in the manufacture and application of fire-resisting cements and materials."—Petition recorded September 21, 1864.

2329. Thomas Walker and Thomas Ferdinand Walker, Birmingham, Warwickshire, "Improvements in means or apparatus for the utilisation of sewage matters, part of which improvements is applicable to raising and forcing other fluids."—Petition recorded September 22, 1864.

2339. William Palmer, jun., Southweald, Essex, "Improvements in the manufacture of candles."—Petition recorded September 3, 1864.

2359. Lewson Alexander and William Bryer Nation, West Ham Lane, West Ham, Essex, "A mode of separating the pitch and spirituous oils from all matters containing them."—Petition recorded September 26, 1864.

Notices to Proceed.

1335. Thomas Drew, the elder, Derby Villa, Tranmere Park, Birkenhead, "Improvements in the manufacture of paper, papier-mâche, and millboard."

1342. William Henry Newton, Chancery Lane, Middlesex, "Improvements in the treatment of the low or poor products obtained in the manufacture or refining of sugar."—A communication from Engéne Bertholomey, Rue St. Sebastien, Paris, France.—Petitions recorded May 30, 1864.

1349. James Young, Bncklersbury, London, "Improvements in the treatment or distillation of bituminous substances."—Petition recorded May 31, 1864.

1366. Oscar Eugen Prieger, Bonn, Prussia, at present residing at Manchester, "The manufacture of ferro-manganese and cupro-manganese, or alloys thereof, with other metals."—Petition recorded June 2, 1864.

1507. William Clark, Chancery Lane, Middlesex, "Improvements in apparatus for washing or dyeing skeins of thread, silk, cotton, or other fibrous materials."—A communication from Claude Viret, Boulevart St. Martin, Paris.—Petition recorded June 17, 1864.

2223. Henry Craven, Baildon, Edinburgh, "Improvements in the manufacture of inks or writing fluids, to be used with certain kinds of paper, for the prevention of fraudulent alterations in bankers' drafts, notes, cheques, and other documents in which it is important to avoid alteration or erasure."—Petition recorded September 12, 1864.

CORRESPONDENCE.

Continental Science.

Paris, October 11.

M. Richter, of Stuttgard, has devised a novel means of extracting the juice from grapes. Instead of pressing them in the ordinary way, he puts them in a drum provided with a suitable strainer, and rotating at the rate of 1000 or 1500 times a minute. The process is said to have the following advantages over the ordinary method:—The time required for the operation is greatly lessened, the whole of the must from 1 cwt. of grapes being obtained in five minutes; the quantity of juice is increased by 5 or 6 per cent.; "stalking" is rendered unnecessary; and the agitated must is so mixed with air that fermentation begins comparatively soon.

Physicists of the most modern school have been somewhat scandalised at M. Dumas for using the term "ether" in speaking of heat, light, electricity, and magnetism in his otherwise magnificent report on the progress of electrical science lately published in the *Moniteur* on the occasion of the award of the 50,000 francs prize to M. Ruhmkorff. *Cosmos* is very hard on M. Dumas for using the expression, and compares the ether theory with some old theatrical effect which has lost its brilliancy, and ought to be put away to rot in obscurity.

A discovery of a very interesting character has just taken place at Pompeii. In examining a certain small street M. Fiorelli perceived under a mass of rubbish a number of hollow places containing vestiges of bones. It immediately occurred to him that these hollows must have once contained the bodies of which the remaining bones formed part. He accordingly caused casts of the holes to be taken, by filling them with plaster of Paris, and was rewarded by obtaining almost perfect representations of four human bodies, in which the clothes, flesh, and hair were reproduced with startling exactitude. One of the bodies is that of a woman, near which was found several pieces of money and some jewels, evidently showing that the unfortunate creature had been overwhelmed as she was flying with her worldly treasures. The head-dress and the texture of her clothes are perfectly distinguishable. The left arm is raised, and the fingers are stiffened in an attitude of agony. The other bodies are those of another woman and a little girl, apparently mother and daughter, the fourth being that of a soldier. The stomachs of all four are greatly swollen, the mouths being open, as if they had been drowned. This gives the notion that the eruption must have been followed by a shower of water.

The *Société Imperiale d'Agriculture* has offered a prize of 2000 francs, to be given in 1867, for the best analyses of the following woods:—Oak (heartwood) of the age of at least forty years (*quercus robur* or *pedunculata*); ash (*fraxinus excelsior*), of the age of at least twenty-five years—the whole of the wood except the liber and bark; pine (*pinus maritima* or *silvestris*) of the same age, and poplar (*populus tremula* or *alba*) of the age of twenty years. Analyses of the same trees five years old are also to be made, with the view of comparing the composition of wood of different ages. Specimens of the woods and of the principles obtained from them, must be sent with each paper.

M. le Verrier is about to cause meteorological observations to be made in all the normal departmental schools throughout the country. M. Charière, a well-known meteorologist, is up in arms about this, and declares that if country schoolmasters' observations are to be relied upon, he will break his instruments and never make an observation again. This is vulgarising science with a vengeance.

In absence of any more interesting news, let me send you a little scandalous anecdote, which you must take *cum grano—cupri sulphatis*.

Not quite one hundred years ago the proprietor of the largest electro-metallurgical establishment near Paris addressed a most respectful letter to the French Academy, requesting that a commission might be sent to inspect his factory and report upon his process for depositing copper on cast or wrought iron objects, such as lamp-posts, statues, fountains, &c. He sent a number of specimens with the letter, but the Academicians either did not know or had forgotten the great encouragement that M. Cinque-Étoiles had received from the Emperor, and they left the meeting without looking at what had been sent for their inspection. However, in a few days it occurred to some one that the Emperor had taken this manufacturer under his particular patronage, and had been over his works several times. A commission was at once appointed, with a president, and secretary, and reporter, &c., &c., &c. They called at the works, inspected the process, praised everything they saw, and wandered about the place for several hours. At last the reporter, who is an illustrious professor, and the author of a standard "*Traité de Physique*," caught sight of a workman varnishing a lamp-post before putting it into the copper bath. The reporter asked the manufacturer what was the intention of this apparently useless operation. The manufacturer replied that if objects in iron were not varnished and then black-leaded, a good deposit could not be obtained. The man of science smiled, and reminded the manufacturer that old birds, especially scientific ones, were not to be caught with chaff. If the manufacturer would only buy his "*Traité de Physique*," he would see that it was only necessary to blacklead the iron article to obtain a perfect deposit. The reporter then related the joke to his colleagues, who laughed and pitied the ignorance of the poor manufacturer, who in the meantime had picked up a piece of cast iron, and was blackleading it as if his life depended on it. The blackleaded iron was put into the copper bath and connected with the battery. A beautiful rose-coloured film of copper spread over the metal, and a triumphant smile over the faces of the lookers on. But shortly the rose-coloured copper changed to a dirty brown powder, and the triumphant smile to a look of perplexity. The surface of the iron at the end of ten minutes consisted of nothing but a dirty brown mixture of powdery copper and decomposed cast iron. The members of the Commission suddenly recollected that they all had particular appointments in different parts of Paris, and made a precipitate retreat from the factory. Strange to say, although a great number of notes were taken, no report has ever appeared, and the succeeding editions of the "*Traité de Physique*" still contain the same erroneous assertion that by merely blackleading cast or wrought iron it may be covered with copper to any thickness by plunging it into a bath of sulphate of copper, and making it the cathode of a voltaic series.

Position of Chemists and Druggists.

To the Editor of the Chemical News.

Sir,—I was pleased to see you drawing particular attention to the address of Mr. Deane at the Pharmaceutical Conference. In that address he states the case of the chemist with great fairness and honest boldness. Mr. Deane is one of the leaders of the Pharmaceutical Society who has never toadied to the "needless jealousy" of professional men, but has always contended for the legitimate rights of the chemist and druggist. A great effort has been made to raise a storm of obloquy against us, for a failing which probably happens less often to us than to prescribers. These have an advantage which compounders unfortunately cannot command. Some one comes after them who can correct their blunders. I, for example, have had some experience in dispensing—as much as most indeed,—and I am not conscious of having caused the death of a single individual. But I am confident that I have saved more than a dozen lives by detecting the mistakes of prescribers. I need not draw examples for my own experience from circumstances which happened years ago, but I will take two instances which have come under my notice lately. Going into a West End shop not many months ago, I was shown a prescription in which a physician had ordered morph. hydrochlor., gr. iij.; ext. hyoscyam., gr. ss., to be taken at bed-time. The blunder was apparent enough, but none the less a blunder. Only a few days ago my attention was called to another prescription, to which I must not now refer.

The number of accidental poisonings quoted by the Medical Officer of the Privy Council is very large, and, as he remarks, the actual number is probably larger. "A general practitioner," as Mr. Deane said, "may and does make numberless mistakes with impunity, because the facts are confined to himself and his own surgery." I could tell of a few, but I do not wish to throw stones. But there is one advantage which the general practitioner has over the chemist to which Mr. Deane did not allude—namely, that the former can sign certificates of death for his patients. Perhaps if druggists could do the same for their customers accidental poisonings would be somewhat fewer.

Moreover, the statement in the Government Officer's Report is likely to create a very false impression, since these "accidental poisonings" must necessarily include all the accidents in manufactories as well as such cases as those related by Mr. Deane; and yet they are all thrown down at the door of the chemist and druggist. This is manifestly unfair, and I must ask your aid in exposing the unfairness. I am, &c.

A Chemist and Druggist.

London, October 10.

A Query.

To the Editor of the Chemical News.

Sir,—Would you allow me, through the medium of your valuable paper, to ask the following question:—Iron wire, when under the influence of a sulphuric acid bath (or vitriol), diluted, is cleansed to a silvery brightness; but a portion of late coming under my notice, instead of leaving the bath bright as usual, came out with a dull black colour, and will not in consequence take the zinc bath, or what is more commonly called the galvanising bath. Some wire iron in the same bath came out with the proper colour—*i.e.*, a silvery lustre. Now, if you or any of your numerous readers can tell me what the iron contains to cause the dull black colour, I shall ever feel grateful.—I am, &c. An Old Subscriber.

MISCELLANEOUS.

New American Process for Separating Gold and Silver.—Mr. E. Balbuck, of Newark, U.S., proposes to melt the lead which contains the gold and silver in a furnace with an inclined hearth, and then to draw it off into a kettle containing a proper quantity of zinc to take up its silver and gold. After being sufficiently stirred for this to be effected, the mixture of lead, silver, gold, and zinc is cast into pigs and remelted in a furnace, with an inclined hearth, at a low heat, sufficient to cause the lead to melt and run off, but not sufficient to melt the zinc, silver, and gold.—*Mining and Smelting Mag.*

Bowditch's New Hydrocarbon Light.—A new method of carburetting coal gas, the invention of the Rev. W. R. Bowditch, was shown in London for the first time on Wednesday last. The method differs from all others hitherto in use, the inventor employing napthaline and the heaviest hydrocarbons as the carburetting agents. These are placed in a gas-tight metallic box into which are soldered two gas-pipes, one for conveying gas into the box, and the other for conveying gas and vapour out of the box to the burner. The burner is fixed to the outlet pipe, and so placed that when gas is being burnt, the hot air from the gas flame must impinge upon the box. This box is provided with a screw-plug through which the hydrocarbon is put into it, and this plug is closed during use. The box being supplied with hydrocarbon, is connected with any ordinary gas-fitting, and the gas is lighted. At first, the gas passes over the surface of the hydrocarbon without being affected, but when the temperature has risen sufficiently to convert the hydrocarbon into vapour, the passing gas carries with it a quantity of the vapour, and the flame becomes highly illuminating, the illumination being proportional to the quantity of vapour present in the flame. As may be imagined, the increase of light is enormous, and from the experiments we witnessed we believe the following extract understates the results:—"In London, 1000 feet of gas costs 4s. 6d., and, as burnt in flat-flame burners, gives the light of 1500 candles. An addition to this of 4½ lbs. of carbolene (as the inventor styles the oils employed) (costing about 9d.) raises its light to that of 7500 candles. In other words, 5000 feet of common gas give the light of 7500 candles, at a cost of 1*l.* 2s. 6d., whereas the same light may be obtained from 1000 feet of carburetted gas at a cost of 9s. 3d., being a saving of 17s. 3d. upon each 5000 feet of gas." The apparatus we should say is perfectly safe, and gives no trouble. A great advantage of the light is the perfect steadiness of the flame.

A Method of Dyeing Moss Green.—Before being employed for artificial flower making, or similar purposes, moss should be dyed green, and this is effected by the following process:—Boil about 2 litres of water, and pour into it 0 kil. ·016 of picric acid, and a proper quantity of carmine indigo. Vary this quantity according to the shade of green desired, adding picric acid, to obtain a lighter tint. Tie the moss in small bundles, and plunge the upper part into the boiling dye for about a minute, then dry it.—*Moniteur Scientifique*, vi. 667, 64.

Lunar Scenery.—Mr. James Nasmyth contributes to the *Journal of Science* an article on the "Physical Aspects of the Moon's Surface," in which he thus describes one of the scenes that would present themselves to a terrestrial spectator if he were placed on the surface of the moon:—"Among the many terribly sublime scenes with which the moon's surface must abound, none can be grander than that which would present itself to the spectator, were he placed inside one of these vast volcanic craters (Tycho, for instance), surrounded on every side by the most terrific evidences of volcanic force in its wildest features. In such a position he would have before him, starting up from the vast plane below, a mighty obelisk-shaped mountain of some 9000 feet in height, casting its intense black shadow over the plateau; and partly up its slope he would see an amphitheatrical range of mountains beyond, which, in spite of their being about forty miles distant, would appear almost in his immediate proximity (owing to the absence of that 'aërial perspective' which in terrestrial scenery imparts a softened aspect to the distant object), so near, indeed, as to reveal every cleft and chasm to the naked eye! This strange commingling of near and distant objects, the inevitable visual consequence of the absence of atmosphere or water, must impart to lunar scenery a terrible aspect—a stern wildness, which may aptly be termed unearthly. And when we seek to picture to ourselves, in addition to the lineaments and conditions of the lunar landscape, the awful effect of an absolutely black firmament, in which every star, visible above the horizon, would shine with a steady brilliancy (all causes of scintillation or twinkling being absent, as these effects are due to the presence of variously heated strata or currents in our atmosphere), or of the vivid and glaring sunlight, with which we have nothing to compare in our subdued solar illumination, made more striking by the contrast of an intensely black sky; if, we say, we would picture to ourselves the wild and unearthly scene that would thus be presented to our gaze, we must search for it in the recollection of some fearful dream."

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. IX. of the Chemical News, containing a copious Index, is now ready, price 10s. 6d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. X. commenced on July 2, 1864, and will be complete in 26 numbers.

A. R.—Common salt is the best thing to use.

A. H. A.—The only edition was published in 1858 by Van Voorst.

W. J. M.—Letter has been sent. Dr. F. Crace Calvert's Cantor Lectures were published in Nos. 240—249.

Books Received.—Companion to the British Pharmacopœia. Second Edition.

Received.—C. Tomlinson; Messrs. Churchill; G. F. Rodwell; P. Squire.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

The Action of Sulphurous Acid on Sulphur,

by M. Berthelot.

According to a recent observation of M. Geitner, pupil of M. Wöhler, a watery solution of sulphurous acid, heated to 200°, decomposes into sulphur and sulphuric acid.

On repeating this experiment, which was successful even between 160° and 180° (sixty-four hours of reaction[*]), I proposed to examine the nature of the sulphur produced. Treated by sulphide of carbon it separated into two parts, a soluble and crystallisable kernel, with an insoluble envelope, the weight of the envelope being much less than that of the kernel.

The formation, under these circumstances, of insoluble sulphur is deserving of attention, for it is formed under the influence of very slow cooling—from 160° to the ordinary temperature. Now, under these conditions, the soluble sulphur is entirely transformed into crystallisable sulphur. It is evident that one of the products in contact with the insoluble sulphur, water, sulphurous or sulphuric acid, has effected its preservation.

From the following experiments it would appear that sulphurous acid possesses this property:—

1. An aqueous solution of sulphurous acid heated to between 110° and 115° with octahedric sulphur during several hours, yielded a melted globule. After cooling it was found that the outer part of the globule was formed of insoluble sulphur, and the inner part of crystallisable sulphur.

2. Octahedric sulphur, heated with pure water, in the same conditions remained completely soluble in sulphide of carbon.

3. An aqueous solution of sulphurous acid, heated alone under the same conditions, undergoes no alteration.

4. Insoluble sulphur, extracted from flour of sulphur and heated with water to between 110° and 115° under similar conditions, melts and changes completely into crystallisable sulphur.

5. The same insoluble sulphur, heated under the same conditions to 110° or 115° with an aqueous solution of sulphurous acid, melts and furnishes a globule exactly like that of octahedric sulphur submitted to the same influences, the outer part being formed of an insoluble coating, the inner of crystallisable sulphur.

6. Octahedric sulphur kept fused between 115° and 120° for a quarter of an hour, under a bed of concentrated sulphuric acid, remains completely soluble.

From these facts it appears that sulphurous acid possesses a specific action for changing crystallisable into insoluble sulphur.

This action is the more remarkable as by melting and then quickly cooling crystallisable sulphur, no formation of insoluble sulphur takes place; at least, when heated above 150° or 160°, as I established long since by some experiments. There is a fixed term, below which not the slightest trace of insoluble sulphur is obtained by sudden cooling. Hence I infer that the molecular transformation of sulphur is not due to the tempering, that is to say, to the abrupt cooling, but to influences anterior to the cooling and independent of it. The abrupt cooling merely insures the permanence of a special state produced under the influence of heat before this cooling takes place.

Sulphurous acid, on the contrary, has a peculiar influence, as it determines the formation of a new molecular state which commences at the fusing temperature of sulphur. This property it shares with nitric acid, as I have elsewhere shown; but the action of sulphurous acid is simpler, it being accompanied by no oxidation or other accessory phenomenon.

I will add, that the formation of insoluble sulphur, under the influence of either sulphurous or nitric acid, seems to require the previous melting of the sulphur. In fact, octahedric sulphur, either heated to 100° for several hours, with an aqueous solution of sulphurous acid, or kept cold during several months, in contact with the same solution, undergoes no alteration. Furthermore, insoluble sulphur (from flour of sulphur) kept at 100°, in contact with an aqueous solution of sulphurous acid gradually changes into crystallisable sulphur, only the transformation is rather slower than with pure water.

I have endeavoured to increase the action of the sulphurous acid by employing this body either in the gaseous state or as anhydrous liquid. The gas between 115° and 120° produced nearly the same effect as its aqueous solution. It is the same with anhydrous and liquid sulphurous acid at the same temperature with this secondary circumstance, that the hot liquified sulphurous acid dissolves by heat a small quantity of sulphur, which during the cooling separates in prismatic crystals.

All these concurrent facts prove that the transformation is effected only by contact with sulphurous acid, which contact transforms the surface, without affecting the centre.

The vesicular structure of flour of sulphur, that is to say, of a variety of sulphur which solidifies in an atmosphere of sulphurous acid, seems to me to be explained partly by the speediness of the cooling, partly by the same cause which operates in the preceding experiments. The vesicle is, in fact, formed of insoluble sulphur enclosing soluble sulphur.

One more instance,—every time sulphur takes the solid state in a chemical reaction or otherwise, in presence of sulphurous acid, it contains a proportion more or less considerable of insoluble sulphur. When sulphur becomes soluble in presence of sulphuretted hydrogen, it is entirely soluble and crystallisable. These are experimental facts.—*Annales de Chemie et de Physique*, I., 392, 64.

On the Presence of Nickel in Metallic Lead,

by Dr. A. T. Machattie, *F.C.S., &c., Glasgow.*[*]

Having had occasion recently to examine some specimens of lead for commercial purposes, I was surprised to find that one of them contained a considerable quantity of nickel; and as I am not aware that nickel is a commonly occurring impurity in lead, or, indeed, that it has been found in commercial lead before, I take this opportunity of recording the results of the analysis made by me of the sample in question.

The composition of the specimen analysed was as follows:—

Lead	82·75
Antimony	10·86
Nickel	5·20
Iron	·86
Loss, including a trace of arsenic . .	·33
	100·00

It will be observed that the above analysis represents a highly impure specimen of lead, for besides the nickel, which gives to it its present interest, the sample contains nearly 11 per cent. of antimony. Such lead could scarcely be used for the ordinary applications of the metal, but the large percentage of antimony might probably recommend it for the manufacture of type metal.

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[*] A solution containing twenty volumes of sulphurous acid is not completely decomposed under these conditions.

[*] Read at the meeting of the British Association at Bath.

The physical characters of the lead were such as to show, even without an analysis, that it was very impure. When trying to divide a portion with an iron chisel, the mass broke with a crystalline fracture, and was not cut like ordinary lead. The brittleness thus exhibited by this alloy is, no doubt, much more due to the antimony than to the nickel, but the latter probably assists in communicating this property to the metal. Again, the specific gravity of this lead is only 9·95, whilst that of pure lead is 11·4 (water = 1); but as nickel has a specific gravity of 8·8, and antimony of 6·8, the low density of the alloy is easily accounted for.

The source of the ore from which the metal was obtained I could not discover, further than that the lead is of German manufacture, which so far explains the presence of such a large proportion of nickel.

On the Dimorphism of Antimonious and Arsenious Acids, by M. H. DEBRAY.

ARSENIOUS and antimonious acids we know are isodimorphous; in fact, according to circumstances, they will crystallise in regular octahedral or in right rhomboidal prisms. I will briefly indicate how antimonious acid may be prepared in either of these forms.

By oxidising antimony at red heat, we obtain prismatic antimonious acid—argentine flowers of antimony—(Sb_2O_3). By pouring a solution of protochloride of antimony (Sb_2Cl_3) in hydrochloric acid drop by drop into a boiling solution of carbonate of soda, the precipitate produced examined under the microscope is, according to Mitscherlich, composed entirely of prismatic crystals. The acid is obtained in octahedral crystals by dissolving hydrate of antimonious acid in a boiling solution of potash, and as the liquid cools small octahedrals are deposited. Mitscherlich has also prepared it in this form by adding hot water to a boiling solution of chloride of antimony in hydrochloric acid, until the moment the precipitate ceases to redissolve. The liquid on cooling gives more numerous crystals than are obtained by any other method. M. Pasteur has obtained octahedrals by the spontaneous transformation of humid oxychloride of antimony (powder of algaroth) into hydrochloric acid and oxide of antimony.

By decomposing algaroth powder by water at about 150°, I found that the matter was integrally transformed into prismatic lamellæ as voluminous as the argentine flowers obtained by the direct roasting of the metal.

This experiment, in addition with those preceding, sufficiently shows the influence of temperature on the crystalline form of antimonious acid, as this body, prepared cold, or at least below 100°, in alkaline or acid liquids, is always octahedral, while the acid obtained in alkaline or acid liquids above 100°, or by the action of heat alone, is always prismatic. I have endeavoured to ascertain whether the temperature of crystallisation influenced in the same way the form of arsenious acid.

As the crystals of arsenious acid obtained by crystallising this body in pure water or in hydrochloric or ammoniacal solutions at a moderate temperature are always octahedral, I heated a large quantity of this acid in a little water, in a closed vessel at about 250°. While cooling microscopic prismatic crystals were first produced, then voluminous octahedrals. At this temperature water dissolved at least its weight of arsenious acid. However, by this process but a small amount of prismatic acid is produced, but it is obtained more easily and in sufficiently voluminous crystals in the following manner: Introduce arsenious acid (vitreous or octahedral) into a long glass tube, which then close by the lamp; place this tube vertically in the axis of a long earthen tube closed at one end by a stopper of luting clay, and fill the space between the tubes with sand. Place the earthen tube vertically on a gas furnace, and surround it with an earthen muff to prevent its cooling; then heat and keep the gas burning for eight or ten hours, and the lower part of the tube soon reaches the temperature of about 400°, but the temperature of the upper part does not at the end of the operation pass 200°. When the apparatus has cooled, vitreous arsenious acid is found at the bottom of the tube, in the middle part prisms visible to the naked eye, and in the upper part beautiful octahedrals without admixture of prisms. The arsenious acid vapours produced in the tube condense at various heights, giving octahedrals in the cold parts, and prisms in those where the temperature was above 200°. Later, when the apparatus has cooled, some octahedrals form in the middle of the tube, but they are evidently deposited on the prisms.

To M. Wœhler is due the discovery of prismatic arsenious acid; he found it in the products of sublimation obtained in the roasting of cobalt and nickel ores. The foregoing experiments seem to me to establish the precise conditions under which this acid is formed. Arsenious acid is generally deposited in octahedrals on the slightly heated sides of the condensing chamber; but if the temperature happen to become considerably elevated prismatic crystals are deposited.

Prismatic arsenious acid had not been elsewhere produced except under the circumstances indicated by M. Pasteur. Arsenite of potash deposits while cooling, in the form of microscopic crystals, the arsenious acid which it dissolves when hot. This experiment shows that the temperature at which the crystallisation in prisms take place depends on the nature of the liquid, for towards 100°, with pure or acidulated water, only octahedral crystals are obtained, but temperature exerts nevertheless an incontestable and frequently predominant influence on the crystalline form. I have proved this, and have ascertained with regard to sulphur which, in sulphide of carbon, crystallises in prisms towards 100°, while at the ordinary temperature this liquid is instantaneously transformed into rhomboidal octahedrals.

Thus, for antimonious and arsenious acids, as for sulphur and carbonate of lime, there are two special stable molecular states at two different temperatures, and corresponding to two incompatible crystalline forms; but between antimonious and arsenious acids and carbonate of lime on the one hand, and sulphur on the other, there is an important difference. Prismatic sulphur prepared towards 110° is stable only at about this temperature, while the prisms of antimonious and arsenious acids and the rhombohedrals of carbonate of lime formed at a more or less elevated temperature are stable even at the ordinary temperature, though antimonious and arsenious acids and carbonate of lime thus formed are, the first octahedral, the second prismatic (arragonite).

But these bodies, like sulphur, can pass by the action of heat from the condition stable at the ordinary temperature, to the form produced by a higher temperature. —*Comptes Rendus*, lviii., 1209, 64.

Action of Sodium on Valerianic Ether,
by J. ALFRED WANKLYN.

WHEN sodium acts upon valerianic ether it displaces the acid-forming radical valeryl, and not the alcohol-forming radical ethyl.

$$2.\left.\begin{matrix}C_5H_9O\\C_2H_5\end{matrix}\right\}O+Na_2=2.\left.\begin{matrix}Na\\C_2H_5\end{matrix}\right\}O+\left.\begin{matrix}C_5H_9O\\C_5H_9O\end{matrix}\right\}$$

The research will appear in detail in the next number of the Chemical Society's Journal.

London Institution, October 17.

Preliminary Notice on a New Earth,
by M. CH. BISCHOF.

IN treating a calcareous mineral by the ordinary reagents, M. Ch. Bischof has discovered an earthy substance which, by its chemical properties, appears to differ from all the other known earths. The following are the different characters assigned to it by the author:—

The new earth is precipitated by sulphide of ammonium; it is more completely precipitated by potash than by ammonia. The precipitate is bluish white, gelatinous, and dissolves sensibly in water. An addition of tartaric acid does not prevent it forming. It is almost completely soluble in carbonate of ammonia. This solution is precipitated by oxalic acid. When this precipitate is intimately mixed with carbon, and the mixture heated in a current of dry chlorine, the chloride of the new base is seen to volatilise; the sublimate obtained is more volatile than chloride of iron. But what characterises more particularly this substance is the manner its chloride comports itself at a high temperature. Heated strongly, the salt splits up into a portion which sublimes in form of a white deposit, and a portion which remains and which presents the characters of a base.

The blowpipe and spectroscope failed to give any decisive reactions. The volatility of the chloride, and the solubility of the oxide in water have prevented M. Ch. Bischof obtaining a large quantity of the earth in question, but he promises a further communication.—*Cosmos*, October 6, 1864.

On the Quantitative Separation of Cerium from Yttrium, Aluminium, Glucinum, Manganese, Iron, and Uranium, by WALCOTT GIBBS, *M.D., Rumford Professor in Harvard University.*

THE relations of the three metallic oxides of the cerium group to sulphate of potash have long been familiar to chemists, and have furnished methods of separation from other oxides which are still in use. In examining this subject I have found that sulphate of soda possesses great advantages over sulphate of potash, the double sulphates of sodium, and the protoxides of cerium, lanthanum, and didymium, being absolutely insoluble in a saturated solution of sulphate of soda. On the other hand, the double sulphates of sodium and glucinum, aluminium, yttrium, protoxide of iron, and sesquioxide of uranium, are readily soluble in sulphate of soda, and may easily be washed out from the highly crystalline insoluble double sulphates of the cerium group. In the analysis of minerals in which cerium occurs with one or more of the other oxides, the following method may be employed with great advantages:—

The oxides are to be brought into the form of sulphates, dissolved in the smallest quantity of water, and a saturated solution of sulphate of soda added, together with a sufficient quantity of the dry sulphate in powder to saturate the water of solution. It is most advantageous to use hot solutions. The insoluble double sulphates of soda and the cerium metals separate immediately, as a white, highly crystalline powder, which is to be brought upon a filter and thoroughly washed with a hot saturated solution of sulphate of soda. After washing, the double sulphates upon the filter are to be dissolved in hot dilute chlorhydric acid, the solution largely diluted with water, and the cerium metals precipitated by oxalate of ammonia, in the manner already pointed out. From the filtrate the oxides of the yttrium group may be precipitated at once by oxalate of ammonia, after peroxidising the iron by means of chlorine water, and rendering the solution slightly acid with chlorhydric or sulphuric acid. The only precaution to be taken in this process is to reduce the iron completely to the form of protosulphate before precipitating the cerium with sulphate of soda. This is best accomplished by means of a current of sulphydric acid gas passed into the hot solution. The precipitated sulphates always contain iron when this precaution has been neglected. This iron is easily detected in the filtrate from the oxalates, and may be precipitated by ammonia, and added to that obtained from the main solution. — *American Journal of Science*, vol. xxxvii., p. 354.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, *F.C.S.*

(Continued from page 77.)

8. **Early Chemistry of the Air.**—From the title of these papers it would naturally be supposed that their object was to give a chemical history of the air, and such was the original intention; but from the fact that many of the experiments of the earlier philosophers are partly physical and partly chemical, and from other causes, I found it impossible to speak of the chemistry of the air alone. I have, therefore, thought it better to give what Mr. Boyle would have called a *physico-chemical* history of the air.

Pneumatics rose to the rank of a science long before chemistry—hence the physical properties of the air were studied before its chemical properties, and hence it follows that the preceding papers have treated of the former rather than of the latter. We have now to consider the early chemistry of the air.

The theory of the mutual convertibility of the four ancient elements was admitted from very early times; it was a tenet in the philosophy of Anaximenes of Miletus, in that of the Stoics, and in that of Aristotle; and it obtained almost universally, either as a whole or in part, till comparatively recent times; we find it admitted in all works on alchemy and chemistry, and in almost all physical treatises published before the 17th century.

As part and parcel of this theory it was believed that water was converted into air by the action of heat, and that air, when submitted to condensation and intense cold, became water.

Among the very few who denied this was Van Helmont,* who maintained that if air could be converted into water by condensation and cold it would assuredly become water in very cold weather when condensed in an air-gun; he adds, moreover, that water never becomes air because if we distil a known weight of water in an alembic we find the same weight in the receiver at the end of the operation, the water being "retorted or struck back" † into its own form again.

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* Born 1577. Died 1644.

† *Alembic* is evidently a word of Arabic origin. Chemistry took its rise in Arabia, and the alembic was probably one of the earliest

Van Helmont was well aware of the evaporation of water at the ordinary temperature, and it was to distinguish this vapour from steam that he introduced the word *gas* into chemistry. "But because," he writes,[‡] "the water which is brought into a vapour by cold is of another condition than a vapour raised by heat, therefore, by the license of a paradox, for want of a name, I have called that vapour *Gas*, being not far severed from the *chaos* of the auntients. In the meantime it is sufficient for me to know that gas is a far more subtile or fine thing than a vapour, mist, or distilled oylinesse, although, as yet, it may be many times thicker than air. But gas itself, materially taken, is water as yet masked with the ferment of composed bodies."

I have invariably seen *gas* derived from the German *geist*: the derivation from *geist* is more plausible than that from *chaos*; nevertheless the latter, although obscure, is not, I conceive, unintelligible.[§]

Hesiod, who is supposed to have lived about 900 B.C., is said to have been the first to introduce the idea of the χάος, but it is probable that he borrowed it from Sanchoniatho,[||] the most ancient heathen writer.

The "chaos of the ancients" was conceived to be a confused mixture of elements, from which, when order and harmony were restored by the Creator, the universe was produced. Now, Van Helmont conceived that water is the primal element, from which everything but air and fire is evolved; all substances, animal, vegetable, and mineral, are produced from it and return to it; hence the vapour of water would be a confused mixture of the elements, or at all events a something from which all material substance could be produced, and inasmuch as this had hitherto received no name, he determined, from its resemblance to the ancient chaos, to call it *chaos*, which by an easy change becomes monosyllabic (chas), and then has almost the sound of *gas*.

From an early age, cupping glasses were caused to draw blood from a patient by placing fire within them to rarefy the air; according to Hero, of Alexandria, the fire "*consumes and rarefies*" the air within them, just in the same way that fire consumes and rarefies water and converts it into air. In the time of Francis Bacon, the experiment of burning a candle in a bell jar inverted over water was well known, Bacon denies that air is consumed by the flame, as some imagined; he explains the rise of water into the jar by supposing that as soon as the flame has been "suffocated by the close air," the water rises to occupy the space previously occupied by the flame, in order to prevent the formation of a vacuum. Van Helmont also denied that air is consumed by fire; this arose from the fact of his failing to distinguish between a body capable of supporting combustion, and a combustible body; if air, he argues, is consumed by fire, the whole air would have been inflamed long ago by one single candle, and would have perished. Moreover, if air could be burnt it would become changed, and would cease to be an element, whereas we know it to be a body not compounded of parts, but simple and unalterable.

The calcination of metals was one of the principal operations practised by the alchemists and early chemists; in all their writings we find a prominent place given to a description of this process.

Massicot and minium (PbO and Pb_3O_4) were much used by the ancients. Klaproth found 10 per cent. of oxide of lead in a specimen of red glass from an Egyptian mummy case; and Davy, on analysing the dark-yellow colouring matter of a piece of stucco found in an ancient Roman ruin, proved it to consist of a mixture of minium and protoxide of lead.

Geber, who wrote in the eighth century, was the first to notice that the calx of lead possessed a different weight from that of the lead which produced it. He writes as follows:—[¶] "Et licet non multum perfectioni approximet, ex eo tamen per nostrum artificium defacili argentum formamus, *et non servat pondus proprium in transmutatione, sed mutatur in novum pondus*. Et hoc totum in magisterio acquirit. Est etiam plumbum argenti examen in cineritio, cujus causas dicemus."

Cardanus[**] added to this fact by stating that the gain of weight amounted to *one thirteenth*[††] the weight of the lead taken. . . . "nam plumbum," he writes,[‡‡] "cum in cerusam vertitur, ac uritur, *tertia decima parte sui ponderis augetur*."

The explanation which Cardanus gives of the cause of the increase of weight is perfectly unintelligible to us, but during the 16th century many theories quite as impossible were brought forward to account for physical phenomena. The lead, he says, during calcination "dies," the celestial heat which gave it life, and rendered it light, is dissipated, and it consequently becomes heavier; just as animals after death become heavier than before, because their celestial heat has vanished.

Cæsalpinus[§§] states that lead gains from 8 to 10 per cent. during calcination. "Peculiare huic," he writes,[||||] "quod derelictum fertilius reviviscit, crescit enim imbribus; unde chemistæ argumentum sumunt, etiam aurum, et argentum augeri posse. Sed illud magis admiratione dignum est, *quod ustum in fornace donec cinis fiat, crescit ejus pondus octo aut decem pro singulis centenariis*, ut metallici testantur."

Cæsalpinus attributed the increase of weight to the presence of soot, which he conceived struck against the dome of the furnace in which the calcination was effected, and being beaten back, fell into the crucible.

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invented chemical vessels: the word *alembicus* frequently occurs in the Latin translation of the works of Geber, the first writer on chemistry. The *retort* is a modification of the alembic, and received its name from *retorqueo*, because the liquid which undergoes distillation is *turned back* from the gaseous condition into its original liquid form.

[‡] "Oriatrike, or Physick Refined." Written by that most Learned, Famous, Profound, and Acute Phylosopher and Chemical Physitian John Baptista Van Helmont, Toparch or Governor in Merode, Royenborch, Oorschot, Pellines, &c. Rendered into English by J. C (John Chandler), sometime of M. H. Oxon. London. 1662.

[§] In order that it may be seen that Mr. Chandler's translation has nothing to do with the obscurity of the sentence, I have given the original below from "Johannis Baptistæ Van Helmont Opera Omnia Francofurti," 1707. p. 69. "Progymnasma Meteori," par 29, in which the sentence stands as follows:—'Verum quia aqua in vaporem, per frigus delata, alterius sortis quam vapor per calorem suscitatus. Ideo paradoxi licentia in nominis egestate halitum illum *gas* vocavi non longè à chao veterum secretum. Sat mihi interim, sciri quod gas vapore, fuligine et stillatis oleositatibus, longe est subtilius, quamquam multoties aere adhuc densius. Materialiter vero ipsum gas aquam esse fermento concretorum larvatam adhuc." The author of the article on Van Helmont in the "Nouvelle Biographie Générale" writes as follows:—"Le nom de *gas* ou *gas* (orthographe de Van Helmont) est derivé par corruption de *gahst* (*geist*) qui signifie *esprit*. Suivant d'autres il derivé de *chaos*, de *blas* (souffle), ou de *gaescht* (écume)."

[||] For the account of the Phœnician cosmogony given by Sanchoniatho, see "Ancient Fragments of the Phœnician, Chaldæan, Egyptian, Tyrian, Indian, Persian, and other writers," &c., by J. P. Cory.

[¶] "Gebiri Philosophi ac Alchemistæ Maximi de Alchemia." 1531. Cap. 35. "Sermo in Saturno." Translated into Latin from the original Arabic.

[**] Born 1501. Died 1576.

[††] 100 parts of lead require 7·173 of oxygen for transformation into PbO; and 9·341 of oxygen for transformation into Pb_3O_4.

[‡‡] "Hieronymi Cardani Medici Mediolanensis De Subtilitate." Libri xxi. Parisiis 1551. Book v. "De mixtione et mixtis imperfectis, seu metallicis."

[§§] Born 1519 Died 1603.

[||||] "De metallicis libri tres: Andrea Cæsalpino auctore." Ad sanctissimum dominum nostrum, Clementem viii. Pont. Max. Romæ. Ex. typographia Aloysii Zannetti, 1596. Lib. 3, cap. 7.

TECHNICAL CHEMISTRY.

On Pyroxylin, by MM. PELOUZE *and* MAUREY.

THE attempts made during the last twenty years to substitute gun-cotton for ordinary powder for fire-arms and mines have resulted in most opposite conclusions. In France, after numerous experiments, it has been discarded on account of its detrimental effect on the metal of fire-arms and accidents from spontaneous combustion and explosion, first brought into notice by a memoir presented by us to the Institute in 1849.

In Austria, General Lenk has continued to occupy himself with the manufacture and use of this explosive material. He prepares it by a process which has been followed on a large scale at Hirtenberg, and which remained for some years a profound secret. But during the last year papers on this subject have been published by German chemists and by General Lenk himself.

It would appear from these papers that the Hirtenberg pyroxylin does not decompose spontaneously, like that made in France at the Bouchet powder factory, and, moreover, differs from the latter in its composition and in the circumstance that its explosive power may be regulated by particular arrangements. We will now examine the value of these assertions, giving the results of some experiments and analyses we have made with the co-operation of MM. Faucher and Chapoteaut.

Processes followed at Hirtenberg and at Bouchet.—The pyroxylin made at Hirtenberg by General Lenk's process is, like the Bouchet pyroxylin, the product of the immersion of cotton in a mixture of monohydrated nitric acid and sulphuric acid at 66°. The two methods, however, differ in several respects.

Thus, the proportions of the two acids are not exactly the same, Lenk's mixture being composed of one part of nitric acid to three of sulphuric acid; that of Bouchet, under the name of unequal volumes, is prepared with one part of the first of these acids and two of the second, equivalent in weight to 1 per 2·46. The above-mentioned memoir gives as being most successful a mixture of three volumes of nitric acid and seven of sulphuric acid (by weight 1 to 2·86), proportions very nearly those given by General Lenk.

At Hirtenberg the cotton is steeped in portions of 100 grammes in 30 kilogrammes of the mixture. It is withdrawn from the bath after being shaken in it for an instant, and each time the quantity of mixture absorbed by the cotton is replaced by a fresh amount. These operations are continued indefinitely, the weight of the mixture being always 300 times that of the cotton.

When the desired quantity of cotton has been steeped, it is put into a receiver and allowed to remain forty-eight hours impregnated by the acids. It is then placed in a strainer, where most of the uncombined acids are expelled in a few minutes.

It is freed from the remainder in a stream of water in which it is washed, and where it remains immersed for six weeks, when it is strained a second time, boiled for two or three minutes in a solution of carbonate of potash of 2° Baumé. After a third and last straining the cotton is dried in the air if the weather is favourable; if not, in a stove of which the temperature is not allowed to exceed 20° C.

General Lenk has latterly made use of a solution of soluble glass of 12° Baumé. The cotton prepared as above is soaked in it, dried, and exposed to the air for a sufficient time to allow the carbonic acid of the atmosphere to combine with the soda of the glass, which determines the precipitation of an insoluble silicate, which, according to General Lenk, "encloses the fibres of the cotton, and prevents the development of gases."

At Bouchet the cotton is steeped in vessels containing only 2 litres of mixture for 200 grammes of cotton, and the steeping is considered complete at the end of an hour.

About 70 per cent. of non-combined acids are pressed out, the cotton being then washed for one or two hours in the river, freed from most of the water by strong pressure, and left for twenty-four hours in an alkaline ley to neutralise the last traces of acids. Withdrawn from this, it is a second time washed in the river, then pressed, and finally dried on a light canvas, through which a ventilator forces cold air.

Soluble glass has not been tried at Bouchet, but we are about to show that it is not so beneficial as it is supposed to be by General Lenk.

Quantity of Pyroxylin produced by a given quantity of Cellulose.—A German report signed by MM. Redtenbacher, Schrötter, and Schneider gives to Lenk's pyroxylin the formula—

$$C_{12}H_7O_7.3NO_5 \text{ or } C_{12}H_7(NO_4)_3O_{10},$$

equivalent to the following composition:—

Carbon	24·24
Hydrogen	2·36
Oxygen	59·26
Nitrogen	14·14
	100·00

The reaction may be explained in two ways:—

1. By admitting that by contact with the mixture of nitric and sulphuric acids the cotton loses the water, which is replaced by the first of these acids—

$$C_{12}H_{10}O_{10} + 3NO_5 = C_{12}H_7O_7.3NO_5 + 3HO.$$

2. By supposing that the hydrogen of the cellulose is replaced by an equal number of equivalents of hyponitric acid—

$$C_{12}H_{10}O_{10} + 3NO_4 = C_{12}H_7(NO_4)_3O_{10} + 3HO.$$

According to this 100 parts of cotton ought to produce 183 of pyroxylin; but though in more than 100 experiments we have varied the proportions of the bodies producing this explosive matter, 178 is the greatest yield we have been able to obtain.

The German report is silent on the subject of the yield, which, in our opinion, constitutes the most solid basis for determining the composition of pyroxylin. We do not say that the exact determination of the yield of cotton in pyroxylin renders useless the elementary analysis of the latter, but it is necessary that the analysis should agree with the figures representing this yield.

Our experiments on the yields have been made with cotton of good quality, previously washed in a boiling solution of carbonate of potash or soap, and then freed as much as possible from foreign bodies, particularly from cotton seeds. Before being used it was carefully dried in a Gay-Lussac stove, between 100° and 115°.

The sulphuric acid marked 66° on the Baumé areometer. The nitric acid had a density of 1·500 at 9°; it was yellow and slightly nitrous.

The relative proportions of the sulphuric and nitric acids were varied so as to present—1. The composition of Lenk's mixture; 2. That of the unequal volumes of Bouchet; 3. Various intermediary proportions between 2 and 3 of sulphuric acid for 1 of nitric acid.

The relative proportions of acid mixture and the weight of cotton were also varied, including those formerly used at Bouchet, and those indicated by General Lenk, until the weight of the acids was 500 times that of the cotton.

The duration of the immersion of the cotton in the acids varied from 1 to 66 hours.

In all these experiments the yields differed very little, never exceeding 178 per cent. of cotton.

The yield in manufactories whether at Hirtenberg or Bouchet is far from being so large as that obtained with small quantities in the laboratory. In fact, General Lenk says that it requires 64·500 kils. of undried cotton to produce 100 kilogrammes of pyroxylin, which corresponds to a yield of 155. Supposing the cotton to contain 6 or 7 per cent. of moisture, the yield of dry cotton at Hirtenberg would have been from 165 to 167 per cent.

The yield at Bouchet, after the working had become regular, was 165·25 per cent.

Though unable to draw from these numbers any conclusion as to the theory of the formation of pyroxylin, we cannot pass over in silence a circumstance as important as the yield, so to speak identical with it, obtained on a large scale in the two factories.

(To be continued.)

On the Frescoes in the Houses of Parliament, by Mr. W. P. King.[*]

THE author has lived on the Durdham Down limestone, and has had the opportunity of observing the walls of buildings built with mortar made with the stone, which has been used in the plaster upon which the frescoes have been painted. He has thus often seen the efflorescences of sulphate of soda such as are seen on the walls of the Houses of Parliament, and therefore predicts the early destruction of the frescoes if especial care be not taken to preserve them. The rationale of the destructive process and the preventative means which should be adopted be described as follows:—When the weather becomes dry, all these bunches of crystalline efflorescence are converted into a loose white powder, much of which drops from the wall, carrying with it shales of plaster, or flakes of paint, or films of whatever material the surface of the wall is covered with. Moisture will condense on the wall, if allowed to grow cold, in damp weather; the white powder is then dissolved, and the liquor, a solution of sulphate of soda, is absorbed by the mortar or plaster. Architects are in the habit of proving the value of the various kinds of stone presented for their use for the endurance of frost by a saturated solution of sulphate of soda, similar to this liquor, which on crystallising imitates the heaving and splitting action of ice forming from water. This liquor is no sooner absorbed, as the wall dries, than it aggregates into ice-like crystals, and the plaster is disintegrated and heaved by the dynamical force developed in their formation. The plaster having sustained this injury, the salt transforms itself, and shoots out into bunches of needle-form crystals, only to fall again into the terrible white powder as the air becomes warm and dry. Thus a constant succession goes on of solution and desiccation with the changes of the weather and temperature, and if the wall be permitted to cool with the frost the ruin of the plaster is insured. Sulphate of soda exists not only in Durdham Down limestone, but unfortunately also in much abundance in all the lias mortars, in London clays, and in many other stones. In fact, the author doubted if any London wall was free from its presence. We may, therefore, observe this kind of action of destruction going on more or less almost everywhere. A marked instance of its injurious effect can be seen in the Crystal Palace, where not only the surface of the richly-decorated walls is attacked, but also the plaster-cast statuary suffers, and requires constant renovation. In Rome and Florence, indeed, many frescoes have remained entire, with their colours smooth and in good order, for hundreds of years; but then these frescoes are on plaster made from travertino, a limestone of fresh water formation, free from salt, and the lime has been burnt with wood charcoal, in which there is no sulphur. In a late view which he had of the admirable fresco which Mr. Herbert has just finished, he found that the robing-room in the House of Lords was kept with a wet floor. If this apartment be ever allowed to grow cold, can we doubt that the fate of this glorious work of art is sealed? Damp will condense in drops on its surface and be absorbed. These drops will dissolve whatever trace of sulphate of soda exists in the plaster, or perhaps in the mortar of the wall. The salt will aggregate together (probably by the force of dialysis), then form ice-like crystals, to heave the plaster and show itself in a bloom on the surface of the fresco, and then dessicate into a dry powder, to be re-dissolved by the first moisture which comes over it, and then be re-absorbed again till at last it aggregates into blotches, and the destruction be complete. To preserve this fresco he recommended that the robing-room be kept always warm and as dry as possible, so that the sulphate of soda may not pass into solution and aggregation; and surely such a work of art, of which the nation is so justly proud, is worth the cost of any expense incurred in its preservation. The "liquid glass process," he understood, had been tried to secure the preservation of Mr. Herbert's fresco, but he doubted its power to prevent the plaster absorbing any drops of moisture which may come on its surface. Indeed, if there be any soda in the preparation of liquid glass it may accelerate the work of destruction, for carbonate of soda is almost as efflorescent a salt as sulphate of soda, into which, however, the former is often converted by the sulphurous acid gas seldom absent from London air. The author concluded that fresco painting on fresh-water limestone walls, kept constantly warm and dry, will have the best chance of endurance for ages yet to come, for the delight of our remote successors.

Preparation of Blue Ink with Prussian Blue, by M. A. Vogel.

PRUSSIAN blue dissolves in oxalic acid, giving a dark blue limpid liquid. This interesting discovery of MM. Stephen and Rasch, patented in England in 1837, is of great interest in tinctorial chemistry, as by its means Prussian blue may be very simply used in the form of a solution. To dissolve commercial Prussian blue in oxalic acid, first mix the blue with concentrated hydrochloric or sulphuric acid, then add an equal weight of water, leave to digest for forty-eight hours, then carefully extract all the acid by repeated washings. This process being minute and tedious, it is better to employ recently precipitated Prussian blue, which does not need the previous treatment by a concentrated acid.

By the following process the author has always obtained a good solid blue ink with Prussian blue and oxalic acid:—

Dissolve in a matrass, in a large quantity of water, ten grammes of sulphate of protoxide of iron; boil, and then add sufficient nitric acid to sesquioxidise all the iron. Then add a solution of yellow prussiate of potash containing ten grammes of this salt and leave the precipitate to deposit. After decanting the supernatant liquid, throw the deposit on a filter, wash with cold water, and leave it to drain until it can be easily raised from the filter with a knife; then, without further drying, mix it in a porcelain mortar with two grammes of oxalic acid in crystals. Let the reaction continue for an hour, then gradually add 400 cubic centimetres of water. A dark blue solution is thus obtained, in which even after long standing no precipitate is to be found. This blue ink will not bear the least addition of black gall-nut ink; it is even advisable not to use a pen retaining a particle of this black ink.—*Moniteur Scientifique*, vi. 666, 64.

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[*] Abstract of paper read at the British Association.

PHARMACY, TOXICOLOGY, &c.

On the Application of Dialysis in Determining the Nature of the Crystalline Constituents of Plants, by J. ATTFIELD, *Ph. D., F.C.S., Director of the Laboratories of the Pharmaceutical Society of Great Britain*[*].

The author had dialysed a few plant juices, the first that came to hand, and from each had obtained some of the crystalline constituents. The tops of the common potato yielded a crop of nitrate of potash, some cubes of chloride of potassium, hexagonal crystals not analysed, sugar, and an ammonia salt. The deadly nightshade gave nitrate of potash, an unknown magnesia salt in square prisms, sugar, &c. Pea-pods yielded only sugar. The common garden lettuce contained nitrate of potash, tetrahedra of undetermined composition, sugar, and ammonia. Cucumbers furnished sugar, ammonia, and sulphate of lime. The cabbage also furnished sulphate of lime and ammonia. Stramonium contained so much nitrate of potash, that dried portions quite deflagrated on being ignited.

From these experiments the author thought the proposed application of dialysis promised to be of great service, directly and indirectly, in investigating vegetable physiology.

In reply to Mr. Groves, who inquired if any of the alkaloids had been detected, the author said that traces of crystalline principles which were not referred to any particular substance were seen, and these possibly were natural salts of the alkaloids. Much larger quantities of material would be needed for their discrimination, and even then the relatively large amount of the colloid as compared with the alkaloid would make the complete isolation of the latter a doubtful problem.

Dr. Edwards was disappointed in the results of the application of dialysis to toxicology, from which much had been expected. If the process was continued for a length of time, portions of the colloid were transmitted through the membrane, and vitiated the result.

Mr. Brough observed that such a condition was inevitable, since there was no absolute line of demarcation in the transfusion of colloids and crystalloids.

PHOTOGRAPHY.

On Perchloride of Copper, by M. RENAULT.

When copper is plunged into bichloride of copper, perchloride of iron, diluted *aqua regia*, a mixture of bichromate of potash and hydrochloric acid, chlorate of potash and diluted hydrochloric acid, or, indeed, into any liquid capable of abandoning chlorine more or less easily, it becomes covered with a greyish white coating, which turns white on contact with cyanoferride of potassium, and afterwards red-brown. Air and water change the colour to yellow; and then the liquid gradually turns to blue. Solution of hydrate of potash, as well as alkaline carbonates, colour it yellow; carbonate of ammonia has the same effect as ammonia, which dissolves and colours it blue. This coating is soluble in hyposulphite of soda, cyanide of potassium, solution of iodine, in iodide of potassium, more or less dilute hydrochloric acid, sulphate of ammonia, &c. Diluted nitric and sulphuric acids do not sensibly alter it, at least when they are not too long in contact.

The most remarkable property of the cuprous chloride thus obtained is the facility with which it alters when exposed to sunlight; its greyish white colour gradually deepens to black, and assumes metallic copper reflections similar to those seen on the fractured surface of prussian blue or indigo. This property made me suppose that it could be used to obtain daguerreotype proofs, and the result showed the correctness of my opinion. A negative placed on a copper plate rendered sensitive by bichloride of copper gave a remarkably fine positive.

When the coating of chloride is sufficiently thin, the redness of the copper seen through the transparent light parts, gives a more agreeable tone than is possessed by the old daguerreotype pictures.

The solvents of the chloride altered by the sun—at least those above mentioned—are the same as those of unaltered protochloride.

The protochloride rapidly dried, sheltered from sun and air, preserves its original whiteness; if in this state exposed to the sun, it takes a very slight yellow tinge. The protochloride used in these experiments had been precipitated from its hydrochloric solution.

If dry white crystalline protochloride is spread on paper and exposed to the sun; and if the same is done with protochloride fused in a platinum vessel and then pulverised, no alteration takes place so long as the dry condition is maintained; but on the addition of a few drops of water each portion of the moistened protochloride paper assumes successively the before-mentioned yellow, grey, black, and violet tints. If the humid state is prolonged, a blue colour is obtained, due to the formation of bichloride.

A sensitive copper plate exposed to the sun and then quickly washed, imparted, with cyanoferride of potassium, no sensible colour to the water.—*Comptes-Rendus*, lix., 329. 64.

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL MEETING.

Wednesday, October 5.

Mr. SANDFORD, *President, in the Chair.*

(Continued from page 188.)

DR. ATTFIELD'S paper was entitled "*A Contribution to the History of Balsam of Peru.*" The history of the balsam of Peru, he said, was still incomplete. Pereira has given precise information as to the localities in which the tree which yields it is found, and the method by which it is extracted; and others have given the testimony of eye witnesses as to the process by which it is collected. Mr. Hanbury has also gathered some historical particulars which has made our knowledge of it more exact. The process which is followed in the State of Salvador is simply this:—The bark of the tree is first loosened by beating it with a mallet; fire is then applied, which causes the bark to drop, and the balsam now exudes from the bared wood of the trunk. The fluid resin is then collected by wrapping rags round the tree, which, when saturated with balsam, are removed and boiled in water to separate the balsam. The chemistry of the balsam has been studied by Frèmy, who found it to be composed of volatile oil, cinnamic acid, and a resin. The state in which the balsam exists in the tree, and the extent to which it may be altered by the process for extraction and exposure, are still unknown. In the hope of learning something about this, Dr. Attfield examined a small branch of the *Myroxylon Pereiræ*, kindly given by Mr. Hanbury, and also a portion of the trunk of the tree from the museum of the Society. The branch was young, and had no heart-wood; the trunk had dark coloured heart-wood nine inches thick, and bark about a quarter of an inch thick. The bark, white wood, and heart were finely rasped and examined separately. In imitation of the process actually adopted, heat was first applied very gradually to a portion of each specimen, but no exudation of balsam took place in either case, nor was any smell of balsam given off. On carrying the heat far enough for destructive distillation to take place, only acid water and tar were obtained. The samples were next boiled in ether, in which the ordinary balsam is soluble. The etherial solutions obtained left, however, on evaporation, only a soft, brownish resin, which had no smell of balsam of Peru. These resinous products, when heated with water, evolved an odour which did not in the least resemble that evolved from balsam of Peru under similar treatment; nor had the water any acid reaction, as water warmed with the balsam always has. Dr. Attfield further proved the absence of cinnamic acid in the products, by endeavouring to form a soda salt, and afterwards decomposing it with hydrochloric acid, but no cinnamic acid could be obtained in this way. Lastly, he examined the etherial residua for the resin of balsam of Peru, by treating each of them with concentrated sulphuric acid. This gives, with the balsams of Peru and Tolu, a persistent dark purple colour, but no colouration was produced with either of the residua. It is thus seen that the balsam of Peru tree contains an oily resin, which is either perfectly distinct from balsam of Peru, or a product of the alteration of the balsam, in which no trace of the constituents of the balsam remains. We must therefore remain in ignorance of the true nature of the balsam and the alteration it undergoes in the charring process, until fresh samples of the bark, wood, and balsam, obtained at the season of collection, can be examined. It would be interesting to know whether a balsamic resin could be procured without charring the bark, or by making deep incisions in the trunk of the tree. The charring appears to be a custom of Indian origin, for it is asserted that the Spaniards obtained the resin without heat. The resin which exudes from the tree spontaneously, Dr. Attfield has shown in a former paper, is not balsamic.

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[*] Read at the meeting of the Pharmaceutical Conference.

After a few remarks by Mr. Hanbury, the meeting was adjourned until Wednesday, November 2, at which meeting Professor Bentley announced that Dr. Daniell would exhibit a specimen of hydrocyanic acid obtained from the Cassava plant.

LECTURES ON CHEMICAL PHILOSOPHY.—V.

Delivered at the College of France, by M. A. Wurtz.

(Continued from page 91.)

Theory of Substitutions.

On January 13, 1834, M. Dumas presented to the Academy of Sciences a memoir, in which he enunciated the following proposition:—

"Chlorine has the singular power of substituting itself for hydrogen, atom for atom."

This simple statement was of great importance. Developing the idea somewhat further a little later, Dumas formulated the law of substitutions in the following terms:—

"1. When a hydrogenated body is submitted to the action of chlorine, bromine, iodine, oxygen, &c., for every atom of hydrogen which it loses it gains an atom of chlorine, bromine, iodine, oxygen, &c.

"2. When the hydrogenated body contains oxygen, the same rule applies without modification.

"3. When the hydrogenated body contains water, this loses its hydrogen without anything replacing it; but starting from this point any new atom of hydrogen removed is replaced as in the preceding cases."

These propositions were founded upon a certain number of facts. Thus Gay Lussac had observed that wax submitted to the action of chlorine lost hydrogen and acquired an equal volume of chlorine. Dumas himself had proved an analogous substitution in the case of naphthaline.

But the discovery which was the immediate occasion of the enunciation of the law of substitutions was that of *chloral*. Chloral is the product of the action of chlorine upon alcohol C_2H_6O: its formula is C_2H_3ClO.

To say the truth, chloral is not a substitution product of alcohol: it is derived from the hydrogenated body C_2H_4O (aldehyde). When chlorine acts upon alcohol, two atoms of hydrogen are removed without any substitution taking place. Thus it is worthy of remark that the author of the law of substitutions had fortuitously met with an exception to this law—an exception which, according to the second proposition indicated above, ought to follow the rule.

Among the labours which have most contributed to confirm the theory of substitutions we must quote the experiments of Laurent on naphthaline.

The action of chlorine upon naphthaline is complex. Chlorine first fixes itself upon naphthaline, and then substitutes itself for hydrogen. We shall now only consider the cases of substitution. Laurent, starting from the primordial compound $C_{20}H_8$,* succeeded in forming the following series:—

$$\begin{gathered} C_{20}H_7Cl \\ C_{20}H_6Cl_2 \\ C_{20}H_5Cl_3 \\ C_{20}H_4Cl_4 \\ C_{20}H_2Cl_6 \\ C_{20}Cl_8 \end{gathered}$$

Dumas had enunciated an empirical law, a simple relation between the chlorine which enters into and the hydrogen which is withdrawn from the compound. Laurent saw much further into the phenomena, and he maintained that chlorine not only took the place of, but played exactly the same part as hydrogen.

Dumas and Laurent compared molecules to edifices: if you remove a stone from a building it must be replaced, or the building falls down. So if you remove one or several atoms from a molecule, the empty spaces must be filled with other molecules. It is clear, therefore, that the new atoms must take the places of the old, and, up to a certain point, play the same part. In this sense the proposition is as evident as indisputable, but Laurent and Dumas intended to give it a much greater extension. They believed that the fundamental properties of a substitutional derivative ought to be identical with those of the original compound.

The similarity of the properties of ordinary acetic acid —$C_2H_4O_2$—and those of trichloracetic acid—$C_2HCl_3O_2$— supported their view. Later, however, it became necessary to give up the idea when chemists discovered the dissimilarity between cinchonine and its chlorine derivatives by substitution. Cinchonine is a base, while the chlorine derivatives lose the basic character, and end by becoming indifferent. A similar remark applies to the chlorine derivatives of aniline, and Gerhardt still later described ammoniacal acids.

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* The author here again adopts the old notation.

The first true extension of the theory of substitutions is due to Laurent. He regarded chemical combinations as containing two kinds of radicals: *fundamental radicals* and *derivative radicals*. Thus, alcohol and ethers all contained, according to him, the fundamental radical or *nucleus* etherine C_4H_4. Add to this radical HO, you have ether C_4H_4HO; add 2HO, and you have alcohol $C_4H_4H_2O_2$; add O_4, and you have acetic acid $C_4H_4O_4$; add Cl_2, and you have Dutch liquid $C_4H_4Cl_2$.

But in the compound C_4H_4 you may replace H_2 by O_2, and thus form a new radical $C_4H_2O_2$, which, united with O_6, forms oxalic acid $C_4H_2O_8$. In the same compound, C_4H_4, H_3 may be replaced by Cl_3 to form C_4HCl_3, which, united with O_4, forms trichloracetic acid $C_4HCl_3O_4$, and, with O_2, forms chloral. In this way we have the following series:—

C_4H_4	etherine.
C_4H_4,HO	ether.
$C_4H_4,2HO$	alcohol.
$C_4H_4O_2,O_6$	oxalic acid.
$C_4H\,Cl_3$.	
$C_4H\,Cl_3,O_2$	chloral.
$C_4H\,Cl_3,O_4$	chloracetic acid.

In the theory of Laurent, $C_4H_2O_2$ and C_4HCl_3 figure as derived radicals.

The theory of nuclei, although it has been adopted by Gmelin in his celebrated "Handbook," has never done great service to science, but it offers the first example of a general theory of organic compounds founded upon a fusion of the theory of radicals with that of substitutions.

Next to the works of Laurent we must notice, as having exercised a notable influence on the development of the theory of substitutions, the researches of Regnault on the chlorinated derivation of Dutch liquid and hydrochloric ether. Starting from hydrochloric ether C_4H_5Cl (equivalents), Regnault effected the following substitutions:—

$C_4H_4Cl_2$
$C_4H_3Cl_3$
$C_4H_2Cl_4$
$C_4H\,Cl_5$
C_4Cl_6

Parallel with the foregoing he succeeded with another series having Dutch liquid for its starting point:—

$C_4H_4Cl_2$
$C_4(H_3Cl)Cl_2$
$C_4(H_2Cl_2)Cl_2$
$C_4(H\,Cl_3)Cl_2$
$C_4Cl_4Cl_2$

The corresponding terms of each of these two series are isomeric, except the last term of the one, which is identical with the last term of the other.

The beautiful experiments of Malsguti on the chlorinated derivations of compound ethers brought a considerable tribute to support the theory of substitutions. We must notice still another important development of the theory, the discoveries of Dumas, relating to the substitution of the group (NO_4) for hydrogen in the compounds called nitrogenised. This was the first instance of the substitution of a group or compound radical for an element, and we know what an extension facts of this kind have given to the theory of substitutions.

Berzelius combatted the theory, and opposed himself to such a natural interpretation of the facts we have mentioned. For each new discovery which seemed to support the theory of substitutions he invented a new hypothesis intended to place the facts in accordance with his preconceived ideas. He invented radicals with inexhaustible fertility, and attributed to the most simple chlorinated compounds formulæ often very complex, but in accordance with his dualistic notions. His efforts have remained sterile, and the resources of his powerful mind exhausted themselves in the ungrateful labour. He made only a semblance of concession a short time before his death by admitting that the substitution of chlorine for hydrogen was possible in radicals, and thus his powerful opposition delayed, but could not prevent, the definite triumph of the theory of substitutions.

We have arrived at the end of our historical *exposé*, and will now consider the facts of substitution and endeavour to penetrate the true sense of the phenomena.

(To be continued.)

ACADEMY OF SCIENCES.

October 10.

M. Carua forwarded an observation he had made *on the phosphorescent matter of the Lampyris italica*. This, when removed from the insect, is an unctuous matter, somewhat resembling melted phosphorus in appearance. When dried on a glass plate, it exhibits no luminosity, but when moistened with water, the phosphoresence returns.

M. Caron continues the apparently interminable discussion *on the action of carbonic oxide on iron*. He contends, in opposition to M. Margueritte, that carbonic oxide has little or no action on iron.

M. Berthelot presented a memoir *on the synthesis of formic acid*. The author, as our readers know, discovered that formic acid is produced by direct synthesis, when carbonic oxide is maintained for some time in contact with caustic potash. He is at a loss to account for this, since the combustion of an equivalent of the acid produces much more heat than that of an equivalent of carbonic oxide. He considers that something more than the ordinary action of affinity is required to explain the production of the acid under these circumstances, and seems to regard it as the result of something analogous to vital force. A new fact now pointed out is that light has no influence on the combination, the change apparently taking place more rapidly in complete darkness.

M. Bechamp contributed a note *on the origin of wine ferments*. The author shows (1) that the presence of air is necessary neither for the development of the ferment nor the commencement of the vinous fermentation, and that the grape brings everything necessary for the perfect accomplishment of all the phenomena; (2) that the surface of the grape may carry the sporules and globules of the ferment; (3) that the stalks and leaves of the vine may carry the same organisms on their spores, which may, in fact, be met with on various parts of other vegetables. The author found, by experiment, that he could set up fermentation in a solution of sugar, by introducing grape stalks and vine leaves, and also by the petals of the red poppy. A microscopic examination of the waxy matter on a ripe grape, he says, reveals the presence of organised bodies identical with those produced in fermentation.

M. Pisani forwarded an analysis of a mineral found in the killas of Cornwall, and named by Professor Maskelyne langite. It contains—

Sulphuric acid	16·77
Oxide of copper	65·92
Lime	0·83
Magnesia	0·29
Water	16·19
	100·00

Which corresponds with the formula $(\dot{Cu})_4\dddot{\bar{S}} + 4\dot{H}$. This mineral differs from brochantite only by containing an atom more water.

Preservation of Silkworms.—M. Onesti has found that wood-soot, if sprinkled over silkworms attacked with *fébrine*, effects an almost certain cure, or, at all events, prolongs their lives until the cocoons are finished. The French Minister of Agriculture has addressed a circular to the *préfets* of the sericultural departments of France, and has requested that a commission be formed to report on the value of M. Onesti's discovery.—*Chronicles of Zoology, "Quarterly Journal of Science."*

NOTICES OF BOOKS.

Zeitschrift für Chemie und Pharmacie, &c. Heft 19. October, 1864.

The original papers in this number of Dr. Erlenmeyer's journal are very short. The first is "*On the Transformation of Helicin into Salicin.*" This is effected by the action of an excess of sodium amalgam on an aqueous solution of helicin. The solution obtained is saturated with carbonic acid, evaporated to dryness, and the salicin extracted from the residue by boiling alcohol. It has all the properties of ordinary salicin. Lissenko publishes "*A Contribution to the History of Zinc Ethyl.*" When anhydrous alcohol is poured upon zinc ethyl a gas is obtained which the author found to be a mixture of hydride of ethyl with 14 per cent. of air. A white, insoluble mass remained in the flask, which Lissenko at first considered to be $\left.\begin{matrix}Zn''\\(\text{Ꞓ}H_3)_2\end{matrix}\right\}\Theta_2$, but which Butlerow has since proved to be $\left.\begin{matrix}[Zn(\text{Ꞓ}_2H_5)]'\\\text{Ꞓ}_2H_5\end{matrix}\right\}\Theta$, or which at least contains a large admixture of this body. The existence of this body he considers to prove the biatomicity of zinc.

The extracted papers include some from the *Comptes-Rendus of the Academy of Sciences* which we have noticed before, and also papers by Fritsche, "*On the Artificial Formation of Gay-Lussite,*" and "*On Double Salts of Oxalate of Lime and Chloride of Calcium.*" The other papers require no notice.

Annales de Chemie et de Physique. August, 1864.

This journal opens with an interesting and important paper by M. Victor de Luynes, entitled "*Researches on Erythrite and its Derivatives.*" It is prefaced by an introduction on alcohols in general, which merits a full translation. The author regards erythrite as a tetra-atomic alcohol of the butylic series. In the course of his experiments he discovered a means of obtaining butylene in a state of purity, and so is enabled to give a more complete account of this body than has hitherto been given. Erythrite treated with fuming hydriodic acid yields, on distillation, hydriodate of butylene, and this decomposed with acetate of silver furnishes pure butylene, which may be condensed into a liquid by means of a freezing mixture. The author further describes the acetate and hydrate of butylene, and concludes with a section on the part which erythrite plays in the immediate principles of certain lichens.

The paper of M. Peligot on the alloys of silver and zinc is here re-published from the *Comptes Rendus.* We learn from a note that the new silver coinage of reduced value is already in circulation in France. The new alloy is composed of 835 parts of silver and 165 parts of copper. M. Peligot's suggestion of the use of a mixture of silver and zinc has not been adopted in the coinage.

In a paper "*On the Transformation of Aldehyde into Alcohol,*" M. Wurtz shows that this transformation is effected by the action of sodium amalgam on a dilute aqueous solution of aldehyde, but by no other means of procuring nascent hydrogen. Why this should be he states it is difficult to say.

In another paper "*On the Transformation of Valeral into Amylic Alcohol,*" M. Wurtz shows that the product formed by the hydrogenation of valeral is not hydrate of butylene or pseudo-amylic alcohol.

M. Coulier, in a paper "*On the Rings of Phosphuretted Hydrogen*" describes a method of showing similar rings which we have heard of before, but may be new to some of our readers. The author recommends the use of a square wooden box with a lid like the lid of a pill box. A small hole is cut in the top of the lid, and the interior is filled with a thick vapour by placing within it two dishes, one with salt and sulphuric acid, the other with sal-ammoniac and lime. When the box is full of vapour raise the lid a little and then shut it sharply down, whereupon a beautiful ring will be seen to issue from the hole at the top. If the hole is made at the side of the box, the ring is projected horizontally, and is better seen by an audience.

The last original paper in the number is by M. Lallemand, "*On the Relation of the Intensity of the Inducing to the Induced Current.*" Most of the articles which appear in abstract in the review of foreign chemical works have already appeared in the Chemical News.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2237. Zoheth Sherman Durfee, Pittsburgh, Pennsylvania, U.S.A., "Improvements in apparatus for generating gas for fuel, and in furnaces for applying gaseous fuel to metallurgical and other operation."—Petition recorded September 13, 1864.

2316. George Scott, jun., Saint Helens, Lancashire, and James Tudor, Weston, Cheshire, "Improvements connected with the manufacture of salt cake."—Petition recorded September 21, 1864.

2336. Michael Henry, 84, Fleet Street, London, "Improvements in dyeing and tanning, and in preparing for dyeing and printing."—A communication from Flavie Victorine Augustine Autier, 33, Boulevart Saint Martin, Paris, France.

2338. Walter Bentley Woodbury, Manchester, Lancashire, "An improved method of producing or obtaining, by the aid of photography, surfaces in 'relievo' and 'intaglio' upon aluminous, vitreous, metallic, or other suitable materials."—Petitions recorded September 23, 1864.

2360. John Atkinson Harrison, Newcastle-upon-Tyne, "Improvements in applying to useful purposes the slag or scoria of blast furnaces used for smelting or melting metals and metallic ores."—Petition recorded September 26, 1864.

2364 Henry Bennison, Burrage-road, Plumstead, Kent, and Hobart Town, Tasmania, "Improvements in fluid meters." Partly his own invention and partly a communication from Frederick Arundel Downing, Hobart Town, Tasmania.—Petition recorded September 27, 1864.

Notices to Proceed.

1310. John Harcourt Brown, Strand, Westminster, "Improvements in treating animal substances for the manufacture of size, pulp, and pulpy matter, and converting the said pulp or pulpy matter into sheets, slabs, blocks, thread, hollow, or tubular articles, and such other articles of commerce for which the said sheets, slabs, blocks, threads, hollow, or tubular articles may be applicable."—Petition recorded May 26, 1864.

1355. Richard Eduard Donovan, Court Duffe, at Castleknock, in the County of Dublin, and Robert Bowles, Blackhall-place, in the city and county of Dublin, "Improvements in the means for the prevention of fraud by altering cheques, drafts, bills, I O U's, and documents of any description relating to the payment and receipt of money." Petition recorded June 1, 1864.

1370. William Henry Mellor, Liverpool, Lancashire, "Improvements in self-acting mashing or saturating apparatus for the use of brewers, distillers, and others."

1375. Frederick Oldfield Ward, Hertford Street, Mayfair, Middlesex, "Improvements in processes and apparatus for treating alkaliferous minerals, to obtain alkalies, alkaline salts, alumina, and accessory products."—Petitions recorded June 2, 1864.

1418. Arthur Thomas Weld, Gravesend, Kent, and John Folliott Powell, Albion Place, Hyde Park, Middlesex, "Improvements in the separation of animal substances from rags of mixed fabric."—Petition recorded June 7, 1864.

1506. Peter Spence, Smedley, New Hall, near Manchester, Lancashire, and Henry Davis Pochin, Broughton, Old Hall, near Manchester aforesaid, "An improvement in smelting copper ore."

1509. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "The manufacture of lyes or liquors applicable to the cleansing and bleaching of wool and other fibrous substances, as well as of textile fabrics."—A communication from Madame Rosine Saiglan Bagnères, Paris, France. —Petitions recorded June 17, 1864.

2060. Henry Parkes, Birmingham, Warwickshire, "Improvements in the manufacture of colours for dyeing, printing, and other uses."—Petition recorded August 19, 1864.

2193. James Fleming, Glasgow, Lanarkshire, Scotland, "Improvements in the treatment of tobacco leaf for the extracting of juice or liquor therefrom."—Petition recorded September 8, 1864.

2222. James Williams, Broad Quay, Bath, Somersetshire, "Improvements in apparatus connected with fermenting, charging, cleansing, or tunning vessels, casks, or vats."—Petition recorded September 12, 1864.

2252. Alfred Vincent Newton, Chancery Lane, Middlesex, "An improved mode of, and apparatus for, preventing incrustation in steam boilers."—A communication from George Tracey Parry, Philadelphia, Pennsylvania, U.S.A.

2254. Auguste Bertsch, Rue Fontaine St. George, Paris, "Improvements in lightning conductors for preventing atmospheric electricity damaging electric telegraph instruments."—Petitions recorded September 15, 1864.

2320. Edward Young, Oughtbridge, near Sheffield, Yorkshire, "Improvements in the manufacture and application of fire-resisting cements and materials."—Petition recorded September 21, 1864.

CORRESPONDENCE.

Continental Science.

Paris, October 17.

The school of horology at Cluses having lately been taken under State protection and suitably endowed, the horological school of Besançon applied to the Minister of Instruction to be placed on the same footing. A negative answer was, however, returned; the municipality of the town have therefore placed a suite of apartments at the disposal of the directors of the school, and have in addition voted them a large sum of money for the purchase of models and machines necessary for the instruction of the pupils. By the way, how is it that England, who stands at the head of the list as regards chronometers, watches, and public clocks, should utterly neglect the construction of domestic timepieces, and leave them in hands of the Germans, French, and Americans?

M. le Verrier is excessively wrath at both M. Charrière and the Abbé Moigno for objecting to his plan of transforming normal schoolmasters into meteorological observers. He announces his intention of sending M. Charrière's letter to all the normal schoolmasters in France, asking their opinion on it, and begging of them not to be angry. He then goes on to accuse the Abbé of personal vanity, and finishes by classing M. Charrière amongst "those individuals who constitute themselves philosophers by purchasing a barometer and thermometer, and then inscribe on their visiting cards—'*M. X., Director of the Observatory of Z!*'" The accusation of vanity is one that the Abbé can well afford to laugh at; but M. le Verrier either forgets or does not know that M. Charrière has been a most accurate and faithful meteorological observer for eighteen or twenty years past, and has published thirty-one tables of very valuable observations. I am afraid M. le Verrier has lost his temper, as he did once before on the occasion of the discovery of a new planet.

A large and brilliant meteor fell near Tarbes on Saturday, September 24th. The detonation, as heard at Mount Stewart, near Pau, was so tremendous that the peasantry rushed out of their houses and fell on their knees, thinking the last day was coming. The sight from Pau was very splendid.

The sale of haschisch has been interdicted by the Turkish Government. Henceforth it can only be sold by chemists and druggists, for purely medicinal purposes. The *Gazette Médicale d'Algerie* wishes for an analogous prohibition in Algeria, where its abuse is carried to an alarming extent. If the use of haschisch is to be prohibited in Algeria, why should not *absinthe* be forbidden in the mother country? Any one who knows anything of the rising generation in France can tell fearful stories about the effects of this pernicious *liqueur* upon the system. The consumption of it is increasing every year, no less than seven and a half million litres having been imported from Switzerland during 1863, to say nothing of the enormous quantities made at home.

M. Morel, who claims to be the inventor of gun-cotton in France, affirms, in contradiction to the assertions of M. de Luca, that he has specimens of that substance which he has kept for eighteen years without undergoing the least alteration, and that when properly made gun-cotton will preserve its properties for an indefinite period. These assertions, I believe, agree with the experiments of General Lenk and Messrs. Abel and Scott Russell.

M. Berthelot's new work, comprising the whole of his lectures on Organic Synthesis, delivered at the College of France during the present year, is making a great sensation. He gives the *coup de grace* to the method of making alcohol from coal gas, by showing that the process is extremely costly and that the resulting alcohol is exceedingly impure. M. Berthelot ventures to hope that fibrin, albumin, ossein, &c., will ultimately be found in the laboratory, an expression that has caused great alarm in the minds of certain persons, who seem to think that M. Berthelot thereby assumes for science the power of creating living beings.

M. Tempel, of Marseilles, has just discovered a new planet, which makes the eighty-first of the group existing between Mars and Jupiter. Its brilliancy is that of a star of the 11th and 12th magnitude. The discovery has been confirmed by the observations of M. Luther, at Bilk.

In the *Journal d'Agriculture Pratique*, M. Barral gives some interesting details on the subject of the manufacture of animal manure at Aubervilliers. This manufactory consumes every year 8000 horses, 200 donkeys, 300 cows, 300 pigs, 9000 cats and dogs, 6000 kilogrammes of meat unfit for food, 500,000 kilogrammes of offal from the Parisian abattoirs, and 600,000 kilogrammes of other refuse animal matters, such as skins, horns, &c. The raw material is first cut up and boiled to extract the grease. The flesh is then separated from the bones, pressed, and dried. It is afterwards ground and sifted, and the dried bones, which are also submitted to the same process, mixed with it, forming a manure containing 35 per cent. of nitrogen and 55 per cent. of phosphate of lime. The blood is collected separately, and also made into manure. The soup obtained in the boiling is strained, and the solid matter thus collected is added to the rest. The offal is piled in alternate layers with other organic matter, such as wool and parings of horn and hoofs, with which is mixed a certain amount of mineral phosphates. The heap is well moistened with the strained soup, fermentation is set up, and the whole is gradually transformed into excellent manure. During this process the phosphate of lime breaks up into phosphoric compounds, more or less soluble, and various salts of ammonia are formed. This is really a much better use to put dead horses to than making them into *saucissons de Lyon* or *filets de bœuf* for the cheap *restaurateurs*.

New Process for Extracting Gold.

To the Editor of the Chemical News.

Sir,—I shall be glad if you will inform me why Dr. Crace Calvert calls his process for extracting gold *new.* Plattner first suggested the use of chlorine for the purpose in 1848, and it was tried with success in Silesia, and has already been suggested for poor Australian quartzes. See the essays published by the Government of Victoria, and freely distributed at the International Exhibition. A similar process was also published by Dr. Schwarz in the *Breslauer Gewerb-blatt*, somewhere in 1860, I think.

I am, &c. A Chemist.

London, October 9.

Answer to a Query.

To the Editor of the Chemical News.

Sir,—If your correspondent will investigate the matter further, he will find that the iron which turned black in his sulphuric acid bath was either steel or a highly carburised iron. I am, &c. S.

MISCELLANEOUS.

Liebig on the Use of Sewage.—Another letter from Baron Liebig, on the use of sewage, has been made public, from which we make a few extracts. It will be seen that the Baron expresses an opinion to which we gave utterance a few weeks ago, namely, that the use of sewage without other manures would prove a delusion:—

"The natural laws which govern the permanent fertility of soils and the increase of their produce are, from circumstances which I cannot detail here, very little understood by the British farmers; and hence arises a fear that the use of sewage, which ought to be a lasting benefit to agriculture, may be regarded, after a few years, as a veritable detriment by the same farmer who, in the first years of its application, would assuredly give it his approbation. In what may be termed its natural state it is not a universal manure, like stable dung, which is efficacious at all times and on all localities, but a special manure, the continual application of which exclusively tends to impoverish the land.

"If clearly understood and properly managed, the employment of sewage will prove a blessing to agriculture; and those who by unwearied perseverance have at last seen the consummation of their labours may justly be looked upon as the benefactors of their fellow-men. But loud would be the outcry should the agriculturist, either by his own ignorance or the want of forethought in others, find himself misled. Our name would then become a byeword, and instead of gratitude be recollected with a curse.

"There are two things which must be done—first, it must be made intelligible to all that sewage in its natural state does not replace stable dung in its entire efficacy, and that, if used exclusively, it will produce abundant crops *only for a time;* secondly, that in each crop the composition of sewage ought to be corrected, according to the nature of the soil, by adding those ingredients which are wanting in sewage, and which the plants to be grown require in the largest proportion.

"The composition of sewage being once perfectly known, a receipt for what is to be added could be made out and put in the hands of every farmer who uses it; and it remains a question whether it is not possible for the company itself to add those ingredients wanting in the sewage according to the demand of the crop to be grown."

This last paragraph in the letter suggests a good deal of work, and we fear will make farmers hesitate about employing the sewage.

Sale of Cyanide of Potassium.—Suicides by means of cyanide of potassium have of late been so frequent as to suggest to chemists much more caution in retailing this highly poisonous salt. It is true that photography is a very popular art, and electrolytic gilding is occasionally practised by amateurs; but we may recommend chemists only to retail the salt to those personally known to them. By so doing many suicides will no doubt be prevented, and something will also be done to avoid the forced restriction on the sale of such articles which will inevitably be placed if the use of the cyanide for the purpose of suicide should extend.

The Influence of Petroleum in America.—Writing on this subject in the *Journal of Science*, Dr. Draper, of New York, says:—"The exact source of petroleum is, up to the present, uncertain, whether it has all been produced by distillation from bituminous coal, anthracite being formed at the same time, or whether it has resulted directly from the bituminous fermentation of marine plants antedating the coal and containing a larger proportion of hydrogen." The amount thrown out by some of the wells is enormous. One of them ejected 3740 barrels a day, three 1000 barrels, one 800 barrels. To "strike ile," has become throughout that region the synonym for rapidly growing wealthy. Transportation to market is effected by carrying it down the stream in vessels, many of which are merely tanks. Occasionally, when collisions occur, thousands of gallons are lost, floating away on the surface of the water. It is proposed to collect the fluid again by means of floating dams, shaped like a V, with the point up stream. The effect that this illuminating agent has produced throughout the country is very striking. It has entirely displaced all other means of lighting, except gas, and is used even in cities by many who desirely an absolutely steady light. The great desideratum is, a perfect chimneyless burner. The petroleum requires a large amount of air for complete combustion of its carbon, and by no other means than a tube six or eight inches long has the supply been rendered sufficient. Although by the substitution of mica for glass the difficulty of breakage has to a certain extent been overcome, there is still great room for improvement. Kerosene, as the oil suited for burning is called, has in one sense increased the length of life among the agricultural population. Those who, on account of the dearness and inefficiency of whale oil, were accustomed to go to bed soon after sunset, and spend almost half their time in sleep, now occupy a portion of the night in reading and other amusements; and this is more particularly true of the winter season.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E C.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Esperanza.—Hall's chlorate of potash is unknown to us.

A Chemist.—The process is a secret.

Photo.—It is not said what uranium salt is used, and we have never seen the preparation.

P. G.—(1) Richardson and Watts' "Chemical Technology," Baillière. (2) A shilling a number. No new edition of Fresenius' "Quantitative Analysis" is preparing.

Communications received from Mr. Tichborne, MM Draper and Whitla, Mr. Catton, Professor Playfair; J. G. B.; P. Squire.

Books Received.—On Skin Diseases, by Tilbury Fox, M.D.; On the Spectra of Some of the Fixed Stars, by Wm. Huggins, F.R.A.S., and W. A. Miller, M.D., LL.D., &c.

THE REPORT ON THE SALE OF POISONS.

THE Privy Council may be congratulated on having secured the services of a very active and zealous Medical officer. In the receipt of a liberal salary, and in possession of a comfortable office, that indefatigable official watches from afar over the welfare of the community, and from time to time deputes some one else to inquire into, and report on, a variety of subjects which concern the public health. And thus it has happened that this year Dr. Alfred Taylor has been requested to report (1) to what extent is injury occasioned by the carelessness and incompetence of persons employed in retailing drugs; and (2) to what extent are unnecessary facilities given for the purchase of poison for criminal purposes.

In answer to the first of these questions, Dr. Taylor relates a number of cases which have occurred within the last thirty years, in which poison has been sold by mistake in grocers' and village general shops, and also a good many in which the mistakes have been made by regular druggists.

On the second question, relating to the facilities given for the purchase of poison for criminal purposes, after remarking that the sale of poisons in this country may be considered as open and free as it possibly can be, Dr. Taylor goes again over the same ground, relating the well-known cases of the Clifton buns, the Bradford lozenges, and the Stourbridge flour. In this section, however, he does respectable druggists some justice by stating his belief that they throw every impediment in the way of the purchase of poison; and he concludes his report with a string of suggestions, which we printed at page 180 of this volume. With regard to these suggestions we may say that they will in general command approval, since they are pretty much the same as have been put forward by chemists whenever the subject has been under discussion.

Mr. Simon comments on this report in a way of which we have but little to complain. We object to the introduction of the remark from the Registrar-General's Report that in the four years 1858-61 1059 cases of accidental poisoning had occurred, because it is likely to create a false impression. Taken in connection with what follows, it seems to suggest that all these fatalities have been caused by the mistakes of tradespeople. But the Committee of the Pharmaceutical Conference, who examined twenty-five cases, reported in the course of two years in the *Pharmaceutical Journal*, very properly pointed out that ten of these twenty-five mistakes were made by administrators of medicines. We know, farther, that a number of accidents occur every year in manufactories; but allowing for these, we are sorry to say there yet remains a large number of fatal mistakes made by parties who, under any alteration in the law, must be entrusted with the sale of drugs and poisons. Hence arises the question of responsibility.

Both Dr. Taylor and Mr. Simon have made some strong remarks on the necessity for the establishment of some legal criterion as to what constitutes *culpable negligence* in the sale of drugs and poisons. This can never be defined by Act of Parliament, and we must presume that the judges know their duties as well as the writers of this report. We may admit, however, that the law as administered does seem lax on this point; but still not more so when dealing with poison fatalities than in many other analogous cases. A badly or hurriedly built house falls down and crushes a number of people in the ruins; there can be no doubt of culpable negligence of the ordinary precautions for safety, but no one is convicted for it. A patched and leaky boiler, which is known to have long been in a dangerous condition, one day bursts and causes the death of a number of people; there is culpable negligence on the part of some one, but the law lets him go free. Again, it is most certainly culpable negligence to dispense or sell from a bottle without taking the trouble to read the label; and so it is to take a gun and point it at another without taking the trouble to see whether or not it is loaded. In the latter case, however, a fatal accident is always considered a pure mischance. Now such accidents, or so-called accidents, as we have named, destroy and injure many more people than accidental poisonings, and we must take care that the law is not stretched to punish one particular class more than another.

Mr. Simon in this Report does not mention the "drunken shop-boy,"* who may dispense strychnia for quinine. The dissipated youth is spared the disgrace of another exposure; but Dr. Taylor testifies to the frequent employment of heedless and entirely unskilled persons in dispensing and vending medicines. The entirely unskilled we hope some day to see weeded out; for the heedless, we are bound to admit that a more liberal interpretation of the words *culpable negligence* might, perhaps, operate as a useful stimulus to carefulness.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Synthesis of Butyric and Caproic Acids,† *by* ALFRED R. CATTON, *B.A.*, *Scholar of St. John's College, Cambridge, and Fellow of the Cambridge Philosophical Society.*

WHEN a saturated solution of acetate of sodium in absolute alcohol is heated with sodium-alcohol for seventy hours, a number of compounds are formed in the isolation and examination of which I have been occupied for several months. My experiments are as yet incomplete, but I have obtained certain preliminary results, some of which it is the object of this paper to describe.

Amongst the compounds formed in the manner referred to are a number of acids of which I have isolated two, and found them to possess the molecular weights and general properties of butyric and caproic acids. The acids are only produced in small quantities, so that the investigation is attended with considerable experimental difficulties.

The apparatus used consisted of a retort which was heated in a sand-bath, and connected by an adapter with a Liebig's condenser, the whole being so arranged that the alcohol which distilled over might be condensed and flow back into the retort. The whole apparatus was dried, previous to use. One part of fused acetate of sodium and about fifteen parts of absolute alcohol were put into the retort, and then heated to the boiling point, which was about 113°—114°C. A quantity of sodium was then introduced into the retort in pieces, and the whole was heated for about seventy hours to the boiling point.

At the end of this time the contents of the retort had become of a dark coffee-brown colour. Excess of alcohol was then distilled off, and the whole of the residue in the retort dissolved in water, filtered from an insoluble resinous-like substance, neutralised with acetic acid and the acetate of sodium partially separated by three crystallisations. The mother liquor, which was rendered slightly acid by the addition of one or two drops of acetic acid, gave a copious light brown precipitate with subacetate of lead.

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* Report on "History and Practice of Vaccination," 1857, p lxiii.

† The experiments described in this paper were communicated to the Chemical Section of the British Association, September 16, 1864.

The acetate of sodium used in these experiments gave no precipitate with subacetate of lead.

The precipitate was collected on a filter and washed with as small a quantity as possible of cold water. It was then suspended in a large quantity of cold water, and decomposed by sulphuretted hydrogen, the gas being passed for more than an hour as a portion of the precipitate appeared to be decomposed with difficulty by sulphuretted hydrogen.

The sulphide of lead was washed by decantations. Excess of sulphuretted hydrogen was expelled from the acid solution by heating and then passing a current of air through it.

The solution thus obtained was colourless and considerably acid to test-paper. The acid or acids thus obtained were, therefore, not acetic acid, but new acids produced in the process.

A part of the solution was neutralised with pure potash and evaporated. The liquid gradually acquired a faint yellow colour which by degrees became deeper, till at last brown scales began to be deposited. The brown deposit was separated by filtration, but it was too small in quantity for analysis.

Nitrate of silver produced in the filtrate a yellowish white precipitate, which was collected on a filter washed with cold water and dried at 100°C.

The silver salt, gradually became brown on exposure to light. I determined, nevertheless, to estimate the silver in a portion of the salt a proceeding which will be justified below.

·3894 grm. of the salt gave ·2729 grm. AgCl. The salt, therefore, contained 52·746 per cent. Ag. Butyrate of silver contains 55·3846 per cent. Ag.

Of course this is of no value as an accurate determination of the quantity of silver in the salt; but it is to be observed that the decomposition of the silver salt would go to augment the percentage of silver. If, therefore, with this decomposition the percentage of silver was less than butyrate, *à fortiori* it would have been if no decomposition had taken place.

The residue of this blackened silver salt was treated with a moderate quantity of boiling water, and filtered till the filtrate became perfectly colourless.

The solution thus obtained did not blacken on exposure to light. No crystals were deposited on cooling, owing to the solution being too dilute. It was, therefore, evaporated in the dark, in vacuo over sulphuric acid. The residue had a rancid odour, and did not blacken. It was dried at 100° C. ·0413 grm. gave ·0216 grm. Ag.

The salt, therefore, contained 52·30002 per cent. Ag. The last determination was 52·746 per cent. Ag.

The quantity, therefore, of the silver salt which had decomposed in the first analysis must have been very small.

From these analyses I concluded that the acid solutions consisted principally of an acid having the same molecular weight as butyric acid mixed with acids containing a higher percentage of carbon.

The problem now was to separate these acids from each other.

The reaction was now repeated from the commencement, and allowed to go on for about seventy hours. The acid solution was obtained as before by precipitation with subacetate of lead and decomposition by sulphuretted hydrogen. It was neutralised with lime water, excess of lime separated by carbonic anhydride, warmed and filtered. After all the carbonate of calcium had been separated by gently heating and filtering several times, the solution was found to have a slightly alkaline reaction on reddened litmus. The liquid was then evaporated, and when reduced to about half its bulk a white flocculent deposit was formed; this could not be carbonate of calcium as it was non-crystalline, and did not effervesce with nitric acid; also it could not have been a basic calcium salt, for in that case the solution would have acquired an acid reaction. Hence the deposit must have been a neutral calcium salt only slightly soluble in water. It was collected on a filter; on evaporating the filtrate it gradually turned yellow, fresh deposits were produced, which became gradually smaller, and these were added to the first.

When the solution had reduced to about seventy parts of water to one of salt, a precipitate was formed more copious than before, and the solution at the same time acquired an acid reaction. The deposit in this instance was therefore a basic calcium salt.

On further evaporation, fresh deposits were formed, the solution becoming at the same time more strongly acid. It was, therefore, impossible to continue the evaporation in the heat farther. The solution was, therefore, again neutralised with lime water, excess of lime separated by carbonic anhydride, warmed, filtered, and evaporated in vacuo over sulphuric acid.

The residue, which smelt like fresh butter, was distinctly separable into two portions, one of which was crystalline, the other amorphous. The amorphous portion had probably been first crystalline, and afterwards given up its water on remaining in vacuo.

The amorphous portion was carefully separated from the crystalline portion and dried in vacuo.

A determination was made of the amount of calcium in the salt.

The salt, on being heated, blackened readily, and gave off an odour resembling acetone. The calcium in the salt was first determined as carbonate of calcium. ·33 grm. of the salt gave ·1594 grm. carbonate of calcium, or ·06376 grm. Ca. The salt, therefore, contained 19·3212 per cent. Ca; butyrate of calcium contains 18·6915 per cent. Ca.

The excess in the quantity of carbonate found was, no doubt, due to the presence of a small quantity of carbonic acid, which would be expelled on heating the carbonate with concentrated sulphuric acid, and then converting it into sulphate. ·33 grm. of the salt gave ·2094 grm. sulphate of calcium, or ·06159 grm. Ca. The salt, therefore, contained 18·6636 per cent. Ca; butyrate of calcium contains 18·6915 per cent. Ca.

These analyses prove conclusively that an acid having the same molecular weight as butyric acid—viz., 88—is produced in the experiment.

I had not enough of the calcium salt to make a carbon and hydrogen determination.

This acid, having the molecular weight 88, possessed also the well-marked characters of butyric acid.

The calcium salt was completely soluble in 5·7 parts of water at 15° C.; but on being heated a considerable portion of the salt was deposited, which, however, redissolved on cooling. On being heated, it blackened readily, gave off an odour resembling acetone, and left a residue of carbonate of calcium.

The copper salt was sparingly soluble. On adding sulphate of copper to a solution of the sodium salt, an immediate precipitate was produced, which, when collected on a filter, was of a bluish green colour. It was perfectly soluble in excess of cold water. No precipitate was produced except in tolerably concentrated solutions.

The silver salt was precipitated on the addition of nitrate of silver to one of the alkaline salts. It was completely soluble in boiling water, and the solution did not blacken on exposure to light.

The alkaline salts gave a copious white precipitate with subacetate of lead.

The sodium salt possessed in the most marked manner the property of rotating upon water. This property, so far as I am aware, is only possessed by the butyrates, propionate of barium, camphor, and eugenic acid (the latter, however, being a liquid). When the mixture of the sodium salts of the acids, obtained by precipitation with subacetate of lead and decomposition by sulphuretted hydrogen, was dissolved in alcohol, and then heated for a short time with sulphuric acid, on standing an oily layer rose to the surface, possessing the odour of the pine apple so characteristic of butyric ether, but not quite so fragrant, probably owing to admixture with the ether of some other acid. The smell of the ether, in fact, resembled more the commercial than pure butyric ether.

These experiments show that an acid having the molecular weight and general characters of butyric acid is produced in the reaction. It remains to show by further experiments that the acid has the same percentage composition, and that the more minute characters, as the crystalline form of its salts, &c., agree with those of butyric acid.

We have stated that the residue after evaporation *in vacuo* of the calcium salts was distinctly separated into two parts, one crystalline, the other amorphous.

In what precedes we have given the details of the examination of the amorphous portion. We now proceed to give the results of the examination of the crystalline portion. Very little of it dissolved in 5·7 parts of water, ¾ths dissolved in 49·4 parts (caproate of calcium requiring for its solution 49·4 parts of water), and the residue did not dissolve entirely in 150 parts of water.

The portion soluble in 49·4 parts of water was evaporated to dryness *in vacuo*. The residue consisted of two parts, one of a light yellowish brown colour, the other quite white. The latter was carefully collected, and found to be soluble in 5·7 parts of water, from which I concluded it to be butyrate of calcium. The former, very curiously, was not entirely soluble in 49·4 parts of water. The soluble portion was again evaporated *in vacuo*. The residue had exactly the same smell as before. It was soluble in 46 parts of water; and as caproate of calcium requires 49·4 parts, I concluded that it consisted of caproate of calcium still mixed with a small quantity of butyrate. The quantity was too small to admit of the caproate being separated from the butyrate of calcium by crystallisation.

A quantity of nitrate of silver, exactly equivalent to the weight of the salt, on the supposition of its being entirely caproate of calcium, was then added to the solution in crystals. The precipitate was collected on a filter, washed with the smallest possible quantity of cold water, and dried at 100° C. It did not blacken on exposure to light. ·136 grm. of the salt gave ·09 grm. AgCl, or ·0677 Ag. The salt, therefore, contained 49·7794 per cent. Ag. Caproate of silver contains 48·4559 per cent. Ag. The excess in the quantity of silver was, no doubt, due to admixture with butyrate of silver.

To return now to the portion of the original crystalline residue, insoluble in 49·4 parts water.

It was collected on a filter, and dried at 100° C.

It was natural to suppose that this was the calcium salt of some higher acid, as caprylic acid.

The following calcium determination proves, however, that such could not be the case:—·046 grm. of the salt gave ·0501 grm. sulphate of calcium;—·046 grm. caprylate of calcium give ·0192 grm. The calcium salts of all higher acids giving less.

Nor could the salt be acetate of calcium; its solubility in water is sufficient at once to negative such a supposition, and ·046 grm. acetate of calcium gave ·0396 grm. sulphate of calcium.

Now, the fact that a solution of caproate of calcium deposits a basic salt when heated suggests the possibility of the salt being a basic caproate of calcium.

The composition of this basic salt has never been determined. Let us assume it to have the simplest composition of a basic salt—viz., $C_{12}H_{11}CaO_4.Ca_2O_2$.

Its decomposition by sulphuric acid would take place as represented by the equation—

$$2(C_{12}H_{11}CaO_4.Ca_2O_2) + 3H_2S_2O_8 =$$
$$2C_{12}H_{12}O_4 + 2H_2O_2 + 3Ca_2S_2O_8.$$

Hence ·046 grm. of such a salt would give 0·491 grm. of sulphate of calcium. ·046 grm. of the salt referred to gave ·0501 gr. sulphate of calcium. The difference between these is only one milligramme.

There can, therefore, be no doubt that the portion of the crystalline residue insoluble in 49·4 parts of water was a basic caproate of calcium having the formula $C_{12}H_{11}CaO_4.Ca_2O_2$.

(To be continued.)

On the Artificial Production of Anhydrite,*
by M. Alphonse Gages.

The circumstances under which natural anhydrite is formed have not yet been well determined. The experiments already made, and bearing upon the various properties of the sulphate of lime and its behaviour at various temperatures, although presenting a great interest, have not yet given crystallised anhydrite under the same conditions as it occurs in the saliferous formations. Gay Lussac had already observed that over-heated gypsum partially lost its well-known properties, and he attributed the cause of it to the partial formation of anhydrite. The experiments of Graham proved, also, that gypsum passes into a kind of amorphous anhydrite at a temperature of 204°. On the meeting of the British Association in Dublin, Dr. Sullivan gave an account of some experiments by which he obtained anhydrous sulphate of lime from its solution in water at a temperature of about 300° Centigrade. The mixture of gypsum and fused salt, treated by water, leaves undissolved prismatic lamellar crystals of anhydrite. Left for many days in water, the quantity of moisture absorbed did not exceed that which some varieties of the natural anhydrite would have absorbed if placed under the same circumstances. I give here the results I obtained:—

Water	0·472
Lime	38·531
Acid sulphuric	60·942
	100·945

Gypsum melted with anhydrous sulphate of soda gives also crystals of anhydrite, but the formation of anhydrite in sulphate of soda requires a higher temperature; but the crystals of anhydrite, separated by water from the sulphate of soda, were perfectly anhydrous. Analysis gave the following, namely:—

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* Read at the meeting of the British Association.

Ca.O.	40·952
SO_3.	59·085
	100·037

Mitscherlich fused gypsum at the highest temperature of the porcelain furnaces, and obtained a white crystalline mass of anhydrite. The occurrence of anhydrite amongst rocks of a sedimentary origin, and the necessity of a temperature higher than the melted lava, has been the great argument employed to prove the impossibility of anhydrite having been formed by fusion. Anhydrite occurs along with rock salt, clays, &c., presenting itself no regular stratification. If we could consider melted chloride of sodium as the solvent in which anhydrite had been produced, the problem would be solved at once, as gypsum dissolves and crystallises in common salt at a temperature far below the melted lava, and not rising above a dull red heat temperature, to which local circumstances may give rise, at such temperature the liquid may possess a great fluidity.

On the Separation and Estimation of Cerium, by WALCOTT GIBBS, *M.D., Rumford Professor in Harvard University.*

THE precipitation of cerium in the form of oxalate from a slightly acid solution is, unquestionably, the most satisfactory method of separating the oxide. The estimation of the oxalate upon a weighed filter is accompanied with the usual trouble and loss of time in perfectly drying the filter before and after collecting the precipitate upon it. By the following mode of proceeding these difficulties may be easily and completely avoided. The solution of cerium (I understand here the usual mixture of cerium, lanthanum, and didymium) when neutral, is to be rendered slightly acid by sulphuric or chlorhydric acid, and then largely diluted with water. Half a litre of water for every estimated gramme of oxide is a good working proportion. The solution is then to be boiled, and a hot solution of oxalic acid or oxalate of ammonia added. On cooling, especially when the solution has been well stirred with a glass rod, or shaken, the oxalate separates in large crystalline grains of a pale rose violet colour. The precipitate is to be filtered off and well washed with boiling water, the washing being extremely easy in consequence of the coarse granular character of the precipitate. The filter is then to be pierced, and the oxalate carefully washed down into a crucible; after which the water in the crucible may easily be removed by evaporation, and the oxalate dried at a temperature of 100° C. The equivalents of lanthanum and didymium are so near to that of cerium, that no very sensible error is committed by considering the mixed oxalates as consisting simply of $CeOC_2O_3 + 3aq$.

In mineral analysis, in which the relative quantity of oxygen in the acids and bases must be determined with accuracy, it may be desirable to ascertain the quantity of oxalic acid in a weighed portion of the oxalates by combustion with oxide of copper. From this the acid in the entire precipitate may be found, and the oxygen in the three bases will then be one-third of the oxygen in the acid.—*American Journal of Science*, vol. xxxvii., p. 354.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, *F.C.S.*

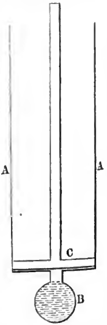
(Continued from page 196.)

9. **John Rey.**—About the year 1628 a M. Le Brun, of Bergerac, calcined 2 lb. 6 oz. of tin, and found on weighing "to ascertain the loss," that the calx weighed 2 lb. 13 oz. He next repeated the experiment with the same weight of lead, and found a loss of 6 oz.* Le Brun mentioned the experiment to several of his friends, but not one of them could give an explanation of the cause of the effects observed, and ultimately he applied to John Rey,† an ingenious physician of his acquaintance residing at Bugue, in Perigord.

The subject was investigated by Rey, and the results of his inquiry were published in 1630 at Bazas, a small town in Provence.‡

Rey's first object was to prove that the air has weight: taking it for granted that bodies cannot descend unless they possess weight, we must admit, he says, that air possesses it, because if we pull a stake out of the ground, air at once rushes in and fills the hole which is left; and however deep we may dig a well, air will descend into it and completely fill it. He mentions, moreover, that if air is compressed in a balloon, the latter on weighing will be found to be heavier than before.

When certain liquids of different density are mixed together they are afterwards found to separate into distinct layers; so, argues Rey, if a long tube were filled with wine the upper layer would be more spirituous than the lower, and hence he infers that the air on the top of a mountain is less dense than that at its base.



Rey believed that water, by the action of heat, is converted into air, and he describes a method of determining the volume of air produced from a known volume of water. A hollow cylinder of metal, AA, open at one end, has an orifice made in the closed end, into which the beak of a small elopile, B, can be fitted air-tight. A piston, C, moves freely in the cylinder. The piston is forced down to the bottom of the cylinder, and the elopile, filled with water, is then securely fitted into its place. Heat is applied to the elopile until the water it contains is completely converted into vapour, and the height to which the piston is raised is noted. By comparing the capacity of the elopile with that of the cylinder below the piston, the relation of the space occupied by the water to that of the space occupied by the vapour produced from it can obviously be readily determined.

The eleventh of Rey's essays is entitled "L'air est rendu pesant par la seperation de ses parties moins pesantes." Just as in distilling wine, a distillate more subtle than wine passes over, and a residue more dense than wine is left in the retort, so, argues Rey, air may be distilled, a "thickened air" being left as residue. We know that air is thickened by the heat of the sun, because soon after sunrise a trembling[§] of the air is sometimes observed. Now, the air near a furnace also trembles, and is therefore thickened. "For the violence of the fire, subtilising all the air that comes near it, will drive an immense quantity of it to a distance, leaving around itself of this immense quantity only a kind of dregs, which from its glutinous weight cannot fly off."

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* The loss was due to an error of manipulation, arising either from the heat of the furnace being too intense, and too long continued, or from the action of the fused oxide on the crucible.

† Born at Bugue during the later part of the 16th century. Died 1645.

‡ Rey's work is entitled "Essays de Jean Rey," Docteur en Mede-

The sixteenth essay is entitled "Response formelle à le demande pourquoy l'estain, et le plomb augmentent de poids quand on les calcine." "To this question, then," he writes, "resting on the foundations I have laid, I answer *et soustiens glorieusement*. That this increase of weight comes from the air, thickened, and made heavy, and in some degree rendered adhesive in the vessel by the violent and long-continued heat of the furnace, which air mixes with the calx (its union being assisted by the continual stirring), and attaches itself to its smallest particles; no otherwise than as water when sand is thrown into it makes it heavier by moistening it and adhering to its smallest grains."

In the eight following essays Rey refutes the opinions of Cardanus and Cæsalpinus, and of several friends of Le Brun, who attributed the increase of weight to the absorption of "the vapours of charcoal," of "the volatile salt of charcoal," of "the volatile mercurial salt," of "moisture attracted by the calx," and of matter removed from the calcining vessel.

In the twenty-fifth essay Rey mentions a single experiment which refutes the opinions of all his adversaries. It will be observed that the above objections are founded on the mode of heating the metal to be calcined; Rey now proves that heat and air alone produce the change.

Hamerus Poppius[‖] mentions an experiment in which he calcined antimony by converging the rays of the sun upon it by a lens. So soon, he writes, as the cone of rays is directed on the antimony, "cum multi fumi profusione calcinabitur . . . . et (quod mirabile) licet copiosas fumus multum de antimonio dissipari arguat, tamen antimonii pondus post calcinationem auctum potius quam diminutum deprehenditur." Now, in this instance, Rey argues, it is impossible that "the vapours of charcoal," or any of the other volatile bodies supposed to be produced during the calcination in a furnace could have attached themselves to the calx, and yet it was found to weigh more than the antimony which produced it.

Rey next answers the question why a calx does not increase in weight *ad infinitum*. Following up the analogy of sand moistened with water, he replies, you may mix sand with sand and water with water in any quantity you please, but this cannot be done with sand and water, for if you add water to sand until it is thoroughly wetted, the sand will take up no more water; it is thus with the calx, the thickened air attaches itself to its most minute parts, "mais quand tout en assublé, elle n'en sçauroit prendre davantage."

Certain bodies, such as lead and tin, have but little volatile matter, and consequently leave a large quantity of ash to attract the thickened air; while other bodies, such as vegetable and animal substances, have a great deal of volatile matter, and consequently leave but a small quantity of ash to attract the thickened air. In the first instance, the air attracted by the calx weighs more than the matter expelled by heat; in the second instance, the air attracted by the calx weighs less than the matter expelled by heat; hence the former class of substances gain weight during calcination, and the latter lose weight—such was Rey's explanation of the fact that all bodies do not gain weight during calcination.

Rey, by careful observation, became convinced that the weight gained by metals during calcination came from the air alone; it was then necessary to construct a theory to show by what means air could produce such an effect; the train of reasoning which induced him to propound the theory given above may be stated in a few words as follows:—Air has weight; air most nearly approaches the nature of a liquid, and may therefore be supposed to act like one; liquids may, by the action of heat, be caused to separate into a heavier and a lighter part; therefore, air may, by the action of heat, be caused to separate into a heavier and a lighter part; the heavier part approaches more nearly to the nature of a liquid than air, it is the "dregs" of air, and it has changed its fluidity for a "viscid grossness;" this matter attaches itself to the ashes of bodies during calcination as water attaches itself to sand, and renders such of them as possess much ash heavier than they were before calcination.

Rey did not believe that "thickened air" (*l'air espessi*) is the *cause* of calcination; he held to the old theory that calcination is the expulsion by heat of the volatile matter of the body calcined, the calx being the residual ash—the ash of an organic body was to his mind as much a calx as the oxide of a metal.

The great merit of Rey was, that he regarded air in the light of a ponderable liquid; that which holds good for a liquid, he assumed, holds equally good for air; he thus became able to grapple with an intangible body, and to reason on that which had hitherto from its subtlety eluded the grasp of the philosophers of all previous ages.

Rey's theory was, indeed, fallacious; still, it was a great step in advance of all that had been done in

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cine: Sur la recherche de la cause pour laquelle l'estain et le plomb augmentent de poids quand on les calcine." The dedication is to the Duc de Bouillon, and is signed "Rey, au Bugue, lieu de ma Naissance dans votre Baronnie de Lymail: le premier jour de Janvier, 1630." The treatise is in the form of twenty-eight short essays, extending over 144 small pages. It is *extremely rare*; a reprint was published in Paris by M. Gobet in 1777, and a translation by Mr. Children appeared in the 21st, 22nd, and 23rd volumes of the *Quarterly Journal of the Royal Institution* for 1821 and 1822. I have consulted the original 1630 edition (of which there is an excellent and complete copy in the British Museum Library), and Mr. Children's translation.

The following curious lines by a M. Bereau, are printed at the commencement of the essays:—

"Rey de plus en delaissant,
Des siecles passez la creance,
Vous trouverez l'air se pesant
Qu'on l'examine a la balance.
Vous verrez que cet element,
Se pese en soy par accident,
Vous verrez comme il se r'affine;
Et par un miracle nouveau
Peu s'en faut qu'il ne se calcine
Par l'effort d'un rouge fourneau."

[§] Rey undoubtedly here alludes to the unsteady appearance which objects possess when seen through air having a different density from that around it,—an effect due to the alteration of the refractive index of the heated air. It sometimes happens after a very hot day that there are layers in the air possessing different densities, the layer in contact with the soil being heated, and then ascending to make way for colder air. Astronomers are frequently unable to work on account of the unsteady appearance of the objects they view—an effect due to the same cause.

[‖] I am unacquainted with this author, neither can I find his name mentioned in the "Biographie Universelle," the "Nouvelle Biographie Générale," Watt's "Bibliotheca Britannica," nor in the catalogue of the British Museum Library. The quotation given in the text is from a work entitled "Basilica Antimonii Comprobata et Conscripta ab Hamero Poppio Thallino Philochymico," cap. iii. "De calcinatione Antimonii per Radios Solares." This work is printed in the "Praxis Chymiatrica" of Jean Hartmann, published in 1625.

former ages; there is impressed upon it the stamp of a great and energetic intellect. We must not judge of it by what has been done since; we must think of what was done before; we must think of it as the work of a man removed from a great centre of learning; from the converse of scientific men; from every external source of knowledge; compelled to work alone, to think alone. Let it be remembered, moreover, that experimental science had not yet left its cradle; middle age superstition was still very rife; philosophy founded on reasoning had not given way to philosophy founded on experiment; the syllogism had not yielded its place to induction; the Church was still dominant—still condemned all that was contrary to the philosophy of Aristotle, and thus cramped and curbed the human intellect; the "Novum Organum" had but just appeared; and the "Dialoghi" of Galileo were as yet unknown to the world. Rey lived at the commencement of an epoch, and he was the founder of a branch of scientific inquiry which helped to render that epoch glorious. By energy and perseverance he ascended a lofty eminence, whence he saw in the distance an unknown country—dimly, indeed, and far from him; still it was there—and he pointed out its direction to his fellow-men, but explorers were rare in that day, and men cared not to venture across pathless wastes, to ascend hitherto untrod mountains, in order to arrive at that which when found, might prove a barren and unproductive country.

Rey's work was but little known during the 147 years which intervened between its publication and its reprint in 1777. It was published in a small and obscure town of Provence, and from the fact that at the time of the reprint it was extremely scarce, it is to be supposed that only a few copies were originally printed. Had it been better known, the theory of Phlogiston would never have been propounded, and pneumatic chemistry would assuredly sooner have attained the rank of a science. But soon after the "Essays" were published, the discovery of the pressure of the air diverted the minds of the scientific from the study of the chemistry of the air.

The claims of Rey have never been sufficiently acknowledged. Let all honour be given to him; science ought to venerate such a man—a true philosopher, working for her, and loving her for herself alone. In the history of pneumatic chemistry, the name of Rey deserves to stand side by side with those of Mayow, Hales, Priestley, Scheele, and Lavoisier.

Well did Rey write as the concluding words of his treatise:—

"Le travail esté mien, le profit en soit au lecteur, et à Dieu seul la gloire."

TECHNICAL CHEMISTRY.

On Pyroxylin, by MM. Pelouze *and* Maurey.

(*Continued from page* 198.)

Composition of Pyroxylin.—In 1847 we determined the composition of pyroxylin, and represented it by the following formula—$C_{24}H_{17}O_{17}.5NO_5$.

We must first find out whether we operated on a product different to Lenk's pyroxylin, and, if the two are chemically identical, whether this formula is correct.

We have conducted these researches with the greatest possible care, and believe we have surmounted the difficulties of the combustion of pyroxylin. We found the pyroxylin of Hirtenberg and Bouchet chemically identical, and found for them a formula differing from the previous one by only one equivalent of water.

This formula is $C_{24}H_{19}O_{19}.5NO_5$.

It is so like the previous formula—$C_{24}H_{17}O_{17}.5NO_5$—that analysis alone would not be sufficient to justify the alteration without being supported by the amount of the yield. In fact, the new formula supposes a yield of 177·78 of pyroxylin for 100 of cotton, while the old formula corresponds to a yield of only 175. The direct experiments described above gave the figure 178.

All the gun-cottons we analysed were previously washed in a mixture of alcohol and ether, to remove some millièmes of fatty and soluble matters, then dried for several hours in a stove at a temperature between 40 and 50°.

All were of the composition above described, and gave the following figures:—

Carbon	25·00
Hydrogen	3·13
Oxygen	59·72
Nitrogen	12·15
	100·00

The Action of Heat on Pyroxylin.—General Lenk ascribes the unsatisfactory results obtained in France by the Commission of 1846 to the fact that not sufficient attention was paid to the manner in which the pyroxylin was prepared, and to operating upon an insufficiently defined nitred product. By taking advantage of conditions most favourable to nitrogenisation, he believes he has obtained a pyroxylin very difficult to decompose.

We will not discuss the theoretical value of this assertion, which does not seem to us to be very great. It is, on the contrary, more probable that gun-cotton would decompose more readily the less like cellulose, and, consequently, the more nitred it became. However this may be, General Lenk says that pyroxylin made by his process will not explode below 136° C.

We have made this important point the subject of numerous experiments.

These experiments were first made with an experimental matrass, open or closed, and plunged into a bath of boiling water.

All the samples heated in this way to 100° were sooner or later decomposed, and in a few minutes a disengagement of nitrous vapours took place.

The decomposition takes place in different ways, and cannot be reproduced at will. Four methods of decomposition at 100°, having the common characteristic of the disengagement of nitrous vapours, may be given:—

1. The pyroxylin detonates violently.
2. It decomposes without detonating, leaving a white, pulverulent, acid residue, partially soluble in water, containing no nitrogen, and forming about half the weight of the pyroxylin.
3. It leaves a yellow, amorphous, inexplosible residue, partially soluble in water, and reducing, like glucose, the double tartrate of copper and potash.
4. It gives a small residue (only 8 to 10 per cent. of its weight), and a black matter, in appearance like charcoal. In this case the matrass is entirely covered with a yellow powder, which dissolves in alkali with considerable disengagement of ammonia (this matter is apparently ulmate of ammonia). From this solution acids precipitate a dirty yellow body, also soluble in alkalies. The charcoal-like residue disengages ammonia under the action of potash. This production of ammonia by the simple action of heat from a matter formed of nitric acid and cellulose is very remarkable.

Other experiments made on various pyroxylins at

90° and then at 80° gave exactly the same results, except that decomposition took place after several hours instead of a few minutes.

At 60°, and even at 55°, pyroxylin is still decomposed. After a few days the matrass becomes full of dense reddish vapours, and the same non-nitrogenised pulverulent residue of which we have already spoken is obtained. No combustion was observed in these latter experiments.

We moreover produced detonation by putting about one gramme of pyroxylin into one of Gay-Lussac's copper stoves containing oil at only 47°. The pyroxylin thus decomposed was from a specimen prepared by forty-eight hours' immersion, and washing by Lenk's process.

These experiments plainly show that, contrary to General Lenk's assertion, his pyroxylin does not offer more resistance to the action of heat than that of Bouchet, the Austrian silicated pyroxylin having under all conditions behaved itself in the same manner as the others.

From its decomposing at about 50°, it may be asked whether pyroxylin is not liable to decompose even at the ordinary temperature. Is it, for instance, likely to detonate spontaneously when kept in large masses in magazines? Several chemists have given examples of the decomposition of pyroxylin at the ordinary temperature. They have generally mentioned as products of this decomposition nitrous vapours and several oxidised bodies like formic, oxalic, and acetic acids, and residues of gummy or saccharine substances, and have endeavoured to ascribe these instances of the alteration of pyroxylin to imperfect washing.

We will in the first place remark that it is easy to wash small quantities of materials, and that as the destructive action of sulphuric acid on pyroxylin is perfectly established, it is evident that the greatest care should be taken to eliminate every trace of it, and that consequently the most careful washing is necessary.

Without entering into the details of the known cases of the decomposition of pyroxylin at the ordinary temperature, we will describe the decomposition we observed in some specimens made in 1847, which had been washed with especial care either in pure or alkaline water.

Of twenty-eight samples placed in small stopped flasks, and a few grammes in weight, sixteen underwent alteration of some kind.

We took at hazard one of the altered specimens, and examined it. It was originally composed of six grammes of pyroxylin which had been washed in potash water and left since March 17, 1850, or fourteen years, in a flask imperfectly stopped. It had left a residue representing 79 per cent. of a dark yellow colour, and considerable amount of acid, but no sulphuric acid. This residue dissolved completely in water, and like glucose reduced tartrate of copper and potash. Its boiling solution gave a decided odour of vinegar, and, what was very remarkable, disengaged ammonia under the action of potash.

There are, then, under the ordinary atmospheric conditions, incontestable instances of the spontaneous alteration of pyroxylin, which, moreover, had been washed in alkaline water.

Now we have shown that pyroxylin is sure to decompose with heat, that in some cases it detonates, and in others apparently identical it is destroyed without combustion. Why should it not be the same at a low temperature? Why should we not add to the instances of simple decomposition those of detonation? The analogy is so evident that we need not have recourse to the supposition of imperfect washing to explain the combustion of pyroxylin.

The Hirtenberg pyroxylin itself exploded in the magazine at Simmering, and in the investigation made July 31, 1862, it was merely decided that the accident was due to spontaneous combustion. It has also been attributed to the ordinary powder also contained in the magazine, but this supposition is inadmissible, as for several centuries there has been no known instance of spontaneous combustion of gunpowder. We must not of course, as was done in an Austrian paper, confound accidents during manufacture, carelessness of workmen, or faulty mechanism, with the explosions produced by no other cause than the reactions among the elements of the compound.

Comparison of Lenk's Pyroxylin with those of Bouchet relative to their Propulsive and Blasting Qualities.—It remains for us to give the results of the experiments made with Navet's pendulum to compare the propelling powers of these two kinds of gun-cotton. Twenty-five charges were fired with Lenk's pyroxylin, fifteen with those of Bouchet, three grammes for each charge, and round balls weighing each 25 gr. 50.

Taking first the medium velocity of the balls and then the greatest and the least, we have,—

	Gun-cotton. Hirtenberg. m.	Gun-cotton. Bouchet. m.
Medium velocity. . .	385·36	394·32
Greatest ,, . . .	441·53	485·94
Least ,, . . .	357·63	357·63

Differences much greater than those presented by the above figures are sometimes found in firing from the same specimen. For instance, the pyroxylin brought from Austria by General Lenk was fired twice, giving—

	m.
On February 17	374·40
,, March 8	408·40

From these results we may conclude that both kinds have the same ballistic force.

In these experiments the gun was filled to the height of 0·05m. It was proposed to ram it harder, reducing the height to 0·03m; but the first charge fired by this method, and with three grammes of General Lenk's pyroxylin, burst the gun barrel.

This accident has also happened in firing charges of the Bouchet pyroxylin, showing the resemblance between the explosive property of the French and Austrian pyroxyles.

We will not here describe all the attempts made by the Commission of 1846 to obviate the inconvenience arising from the too rapid combustion of pyroxylin, but will confine ourselves to those made for the same purpose by General Lenk.

He first unsuccessfully tried compressed cartridges, then some which he called long cartridges, formed of paper cylinders covered with gun-cotton yarn. With these an Austrian 12-pounder charged with about 481 grammes of gun-cotton gave a velocity of 427 metres.

But this speed, though the greatest attained by the experiments in question, is less than that obtained in France with a similar gun, and with a charge of 2 kilogrammes of ordinary powder, which was about 480 metres, and which the Commission of 1846 endeavoured to attain by using 667 grammes of pyroxylin.

Now, it has not been proved that Lenk's cartridges would not injure pieces of ordnance were the quantity of pyroxylin increased so as to obtain the same speed as in France.

The author of one of the Austrian reports recognises the fact that the results obtained are unsatisfactory, and that the mechanical means employed to prevent the development of the injurious properties of the pyroxylin neutralise part of its propelling power; and arrives at the conclusion that the problem will be resolved only when firearms are made in which the injurious effect may be disregarded. This is also our opinion; but how to overcome the objection of the spontaneous explosions, which to us is the first consideration?

The result of our researches is that though the composition, method of production, and chemical properties of pyroxylin may be better known, the principal point—its use for firearms—remains in nearly the same state in which it was left by the French Commission of 1846.

There is nothing to lead us to suppose it possible, in the present state of our knowledge, to prevent the spontaneous explosion of pyroxylin, or to get rid of its injurious properties.—*Comptes Rendus*, lix., 363. 64.

PHARMACY, TOXICOLOGY, &c.

On the Extraction of Cantharidin, and on the Assay of Cantharides, by M. Mortreux.

Having observed that cantharidin is insoluble in sulphuret of carbon, it occurred to me that this property might be employed in isolating the active principle of cantharides.

If cantharides are treated by chloroform, as has been indicated by Mr. William Proctor, and the solution is evaporated, the cantharidin is obtained in the form of crystals disseminated in solid fat and green oil.

By now employing the sulphuret of carbon, this vehicle dissolves the fatty bodies, and leaves the cantharidin nearly pure, which it is easy to collect on a filter and wash and weigh.

The study that I have made of these facts leads me to found on them a process for assaying cantharidin in cantharides. Here is the *modus operandi* I offer :—

Introduce into the adapter of Payen's apparatus, for extraction by vapour, (a vapour percolator,) a wad of cotton, and on this a layer of fine washed sand, 10 to 15 millimetres.

The cantharides to be examined being reduced to fine powder, 40 grammes (617 grains) are taken and placed on the layer of sand, when it is settled by jarring the beak of the adapter on the table; over the cantharides is put a thin layer of cotton, and above this a circle of filtering paper.

The adapter is then inserted in a flask containing three or four cubic centimetres of ether, which flask is connected by a lateral tube with another flask surmounting the adapter. The apparatus is then heated in a water-bath, and when the vapour arrives in the upper flask about sixty cubic centimetres of concentrated ether are poured in the adapter and a safety tube adapted.

The distillation is continued until the liquor passes colourless (about three hours are required), when the apparatus is removed from the water-bath; the upper flask removed, ten cubic centimetres of ether added, and on this disappearing below the paper, water is poured on to displace the ether. The ether is distilled off, and the residue, after the total disappearance of the ether, is treated with fifty to sixty cubic centimetres of sulphuret of carbon, and the whole thrown upon a double paper filter and well washed with sulphuret of carbon by means of a pipette.

The filters are then dried and weighed, the difference in weight between the empty filter and that containing the cantharidin gives the weight of that principle contained in forty grammes of the cantharides treated.

By this method, in several assays, the product has ranged between eighteen and twenty-two centigrammes per forty grammes, an average of 20 centigrammes in 4000 centigrammes.* This process can easily be applied to the preparation of cantharidin for commerce.—*Jour. de Pharmacie*, Juillet, 1864.

On the Extraction and Preservation of Aromata, by Chas. R. C. Tichborne, *F.C.S., &c.*†

Some time ago I noticed in my garden a vegetable curiosity. As I was desirous of preserving this *lusus naturæ* for some time, I submerged it in some weak glycerine, considering that that fluid would be less likely to destroy the tender organism, and also remembering that it had been found most efficient in the preserving of animal tissues.‡ The glycerine answered its purpose admirably, preserving the delicate parts of the plant—preventing decomposition. I immediately saw that this property of glycerine might be made available for certain pharmaceutical purposes where it was desired to preserve or to extract the aromata of vegetable products. It is applicable to the preserving of elder, orange, or rose flowers, and also, as will be shortly explained, it may be substituted for the oils and fats used in the process termed enfleurage.

The flowers may be preserved for making the official *aqua sambuci* for an indefinite period, the following being the *modus operandi*:—The elder flowers should be gathered when the corolla is fully expanded, but not too far gone; they should then be plucked from the stem, and packed firmly in wide mouthed bottles, or jars, without crushing them; the whole should then be well covered with glycerine and corked. It is not necessary that the glycerine should be pure for this purpose, but it should be devoid of odour, and have a specific gravity of about 1·240 at 60° F.§

The common glycerine made from soap or plaster has generally a slight odour, which must be got rid of before using it.

When the flowers are wanted for the distillation of the water, they are put into the still, or, what is preferable, the glycerine is expressed, and is then found to be saturated with the essential oil; water is then added, the quantity being regulated by the original weight of the preserved flowers.

I have preserved flowers for two years, and on distilling them this summer I have procured a water, the perfume of which has equalled the most recent product. As the otto seems soluble in all reasonable proportions, this is a very convenient method of making a concentrated water, either by treating the glycerine after expression with a fresh portion of flowers or by regulating the amount of water added on distillation.

This process of preserving the flowers will be found to far exceed the old plan in general utility, but in particular, as it is almost next to impossible to distil the flowers so preserved without a small portion of the salt being mechanically carried over, which cannot be a desideratum in an emollient.

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* This is more than was found by Warner, who obtained 2·03 parts from 500, or 0·4 from 100, whilst the above is 0·5 per cent.

† Read at the Pharmaceutical Conference. We have already published a short abstract of this paper, but now print it at length. We shall do the same with other papers read at the Pharmaceutical Conference as they reach us.

‡ Experiments of M. De Marquay—*Journal de Chimie Médicale.*

§ Pure distilled glycerine has generally a specific gravity of about 1·241 at 60° F.; but the ordinary glycerine may be concentrated upon a water-bath until it has a specific gravity 1·240.

By shaking the expressed glycerine, diluted with warm water and melted lard, and then allowing them to separate, an ointment may be obtained which has the natural properties and aroma of the elder flowers.

I will now draw your attention to what may probably be a very useful application of the above properties of glycerine. I mean in cases where the aroma of the flower is so delicate as to be much injured, if not entirely destroyed, by the application of heat; when such is the case, the extraction of the perfume by glycerine may be substituted for the process of enfleurage as now carried on to such a large extent at Grasse and Cannes, and which is an extraction by fats.

The process would then become one of cold maceration, no heat being employed in the *bain*. After macerating the flowers for some considerable time in the glycerine, it is expressed, and again treated with fresh flowers until the excipient is thoroughly saturated with otto. The extraction seems perfect, as the glycerine evidently has a great affinity for volatile oils.[‖] The saturated glycerine is then diluted with water, and shaken with a small quantity of chloroform. After well agitating, the latter is allowed to subside; it carries down with it nearly the whole of the essential oil. This chloroform solution, after being separated by a funnel, should be filtered and allowed to evaporate spontaneously in a shallow vessel; the residual matter dissolved in spirit forms the spirituous extract of the flowers, whatever that may be. If operating upon large quantities it becomes desirable to economise; therefore, in such a case, the greater part of the chloroform may be drawn off in a still, the last portions being allowed to evaporate spontaneously. The boiling point is so low that even the most delicate perfume would hardly be deteriorated by the heot employed. Even the offensive smelling bisulphide of carbon, from its ready volatility, might be used, it being cheaper, but it must be quite pure or free from other sulphur compounds. The glycerine may be used over and over ogain by diluting, passing it through charcoal, and then evaporating it to the desired gravity.

As regards the application of glycerine to the preserving of leaves, &c., for distilled waters, I have myself practically carried it out with great success, having kept flowers for two years, and on opening them found not only the perfume natural, but the structure of the flowers without the least disorganisation.

I merely throw out these remarks on the process called enfleurage as a suggestion, as it could only be practically put to the proof at some place where the flowers are cultivated extensively. The great number of men and women required in that process as now carried on in the Var[¶] district would point out that a great saving would be made both in time and money by a method similar to the above. Another object is, that although there are lorge growers at those localities, the mass of the flowers are grown by cottagers, and collected from them by *commissionaires*. In the above plan the flowers could be placed in perfect safety as brought in, and by this means all danger from heating by fermentation is thrown out of consideration. I have extracted on a small scale and by the above means the aromata from heliotrope, wallflower, and other flowers.

PROCEEDINGS OF SOCIETIES.

LECTURES ON CHEMICAL PHILOSOPHY.—V.

Delivered at the College of France, by M. A. Wurtz.

(Continued from page 201.)

On Substitutions.

We may distinguish three classes of facts relative to substitutions—1. The substitution of simple bodies for simple bodies; 2. The substitution of compound radicals for simple bodies; 3. The substitution of compound radicals for compound radicals.

As regards the substitution of chlorine for other simple bodies, wa shall remark that the amount of chlorine which becomes active is always a molecule Cl_2, or a group of molecules Cl_4 or Cl_6, &c., but never an atom or an uneven number of atoms. The following reactions will show this:—

$$\underbrace{C_2H_3H.Cl_2}_{\text{Chloride of ethylene.}} + Cl_2 = \underbrace{C_2H_2Cl.Cl_2}_{\text{Chlorinated chloride of ethylene.}} + HCl$$

$$\underbrace{C_2HH_3Cl_2}_{\text{Chloride of ethylene.}} + Cl_4 = \underbrace{C_2HCl_3.Cl_2}_{\text{Terchlorinated chloride of ethylene.}} + 3HCl$$

These metamorphoses are double decompositions, double substitutions, in which the hydrogen and the chlorine are exchanged volume for volume, atom for atom, exactly as silver and sodium are substituted for one another in the reaction of chloride of sodium on nitrata of silver—

$$AgNO_3 + NaCl = AgCl + NaNO_3.$$

Further, a chlorinated substitution compound being given, we can reproduce the original compound also by a double decomposition. For example, Melsens, by acting on terchloracetic acid, $C_2HCl_3O_2$, with sodium amalgam in the presence of water, reproduced acetic acid—

$$C_2HCl_3O_2 + 3H_2 = 3HCl + C_2H_4O_2.$$

Thus we see chlorine, and we may add bromine and iodine, replacing hydrogen volume for volume, atom for atom. This shows that the atoms of these different bodies are equal to one another, or possess the same value in substitutions.

Let us now examine some other cases of substitution: the reactions of oxygen on alcohol, for example. In this case there is the formation of acetic acid, which we can prove is effected by the following double decomposition:—

$$\underbrace{C_2H_4H_2O}_{\text{Alcohol.}} + O_2 = \underbrace{C_2H_4O_2}_{\text{Acetic acid.}} + H_2O$$

In this reaction one atom of oxygen is substituted for two atoms of hydrogen, and this happens in all reactioos; to replace one volume of oxygen, two volumes of hydrogen are necessary. We know, besides, that one atom of oxygen combines with two atoms of hydrogen to form the stable compound H_2O. We conclude from this that one atom of oxygen is equal to two atoms of hydrogen, or, in other words, that oxygen has a combining power and a substitutional value double that of hydrogen. Whilst one volume or one atom of hydrogen combines with one atom or volume of chlorine to form two volumes of hydrochloric acid, two volumes or atoms of hydrogen are required to form with one atom or volume of oxygen, two volumes of tha vapour of water.

We can also substitute oxygen for chlorine, and woobserve that it proves the following double decomposition:—

$$\underbrace{PCl_3Cl_2}_{\text{Perchloride of phosphorus.}} + H_2O = 2HCl + \underbrace{PCl_3O.}_{\text{Oxychloride of phosphorus.}}$$

Here we see that one atom of oxygen is equal to two atoms of chlorine, which in themselves are equivalent to two atoms of hydrogen.

Phosphorus furnishes us with another example of substitution; it takes the place of three atoms of hydrogen, is equivalent to three atoms of hydrogen. Thus, in the

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[‖] Fresh mint suspended over a thin stratum of glycerine imparts in a short time a considerable odour to that fluid.

[¶] There are annually grown at the district of the Var, 2,284,000 lbs. of flowers for the process of enfleurage.

formation of phosphorous acid, the following metamorphosis is effected :—

$$\underbrace{PCl_3}_{\text{Terchloride of phosphorus.}} + H_3H_3O_3 = \underbrace{PH_3O_3}_{\text{Phosphorous acid.}} + H_3Cl_3.$$

We arrive, then, at the following conclusions :—

1. That one atom of chlorine may be substituted for one atom of hydrogen, or is equal to one atom of hydrogen.

2. That one atom of oxygen may be substituted for, and may combine with two atoms of hydrogen, or is equivalent to two atoms of hydrogen.

3. That one atom of phosphorus may be substituted for, and combine with three atoms of hydrogen or is equivalent to three atoms of hydrogen.

With chlorine we may class bromine, iodine, and fluorine; with oxygen, sulphur, and selenium; with phosphorus, nitrogen, &c. To the elements belonging to the first group we give the name *monatomic* since their substitutional value or combining power is equal to 1; those of the second group we call *diatomic*, since their value is equal to 2; and those of the third we name *triatomic*, for the reason that their value in substitution is equal to 3.

We shall see by-and-by that we can rise still higher, and we shall have to unfold the history of *tetra-* and *penta-*atomic elements.

Let us pass to the substitution of compound radicals for simple bodies. One of the first examples of such a substitution we meet with is that of the formation of nitrobenzole by the action of nitric acid on benzole. In the metamorphosis we have the substitution of the group NO_2 for H.

$$\underbrace{C_6H_5H}_{\text{Benzole.}} + \underbrace{NO_2HO}_{\text{Nitric acid.}} = \underbrace{C_6H_5NO_2}_{\text{Nitro-benzole.}} + H_2O.$$

An analogous double decomposition takes place in the reaction of bromide of ethyl on ammonia :—

$$C_2H_5Br + \left.\begin{matrix}H\\H\\H\end{matrix}\right\}N = BrH + \left.\begin{matrix}C_2H_5\\H\\H\end{matrix}\right\}N.$$

A reaction which shows the atomic equivalence of hydrogen and the group C_2H_5

The formation of acetate of ethyl is similar :—

$$C_2H_5I + \left.\begin{matrix}C_2H_3O\\Ag\end{matrix}\right\}O = AgI + \left.\begin{matrix}C_2H_3O\\C_2H_5\end{matrix}\right\}O.$$

Here we see that an organic group is substituted for the metal Ag. There are then organic groups (NO_2, C_2H_5), which substitute themselves for and combine with one atom of hydrogen. These groups are comparable to the monatomic elements, and we shall call them *monatomic radicals*.

There are also polyatomic radicals. Thus, if we mix chloroxycarbonic gas with water, the group CO is substituted for H_2.

$$COCl_2 + H_2O = 2HCl + CO.O(CO_2).$$

Thus CO, which combines with Cl_2, may be substituted for the H_2 of the water. The combining or substitution value of the group CO is double that of H, equal to H_2; the group then is diatomic.

Let us notice in passing that this similarity of action and atomicity which we discover to exist between the mineral elements and the organic compound radicals contributes greatly to bring together the two chemistries.

The following equations show some other examples of diatomic groups :—

$$\underbrace{SO_2Cl_2}_{\text{Chloride of sulphuryle.}} + H_2H_2O_2 = H_2Cl_2 + \underbrace{SO_2H_2O_2}_{\text{Sulphuric acid.}}.$$

$$\underbrace{C_2H_4I}_{\text{Iodide of ethyle.}} + \underbrace{\left.\begin{matrix}AgC_2H_3O_2\\AgC_2H_3O_2\end{matrix}\right\}}_{\text{Acetate of silver.}} = 2AgI + C_2H_4\underbrace{\left\{\begin{matrix}C_2H_3O_2\\C_2H_3O_2.\end{matrix}\right.}_{\text{Acetate of ethylene.}}$$

In the first reaction we see the diatomic group sulphuryle SO_2 (sulphurous acid) substituted for H_2; in the second, the diatomic group C_2H_4 substitutes itself for 2Ag in the two molecules of acetate of silver, and binds together the remaining elements of these molecules.

Lastly, we arrive at triatomic radicals, that is to say, groups which may be substituted for H_3. The formation of phosphoric acid gives us an example of such a substitution.

$$\underbrace{POCl_3}_{\text{Chloride of phosphoryle, or, oxychloride of phosphorus.}} + H_3H_3O_3 = \underbrace{POH_3O_3}_{\text{Phosphoric acid.}} + H_3Cl_3$$

Here we see the group PO substituted for H_3.

The production of Berthelot's triacetine furnishes us with another example :—

$$C_3H_5Br_3 + \left.\begin{matrix}AgC_2H_3O_2\\AgC_2H_3O_2\\AgC_2H_3O_2\end{matrix}\right\} = 3AgBr + C_3H_5\left\{\begin{matrix}C_2H_3O_2\\C_2H_3O_2\\C_2H_3O_2\end{matrix}\right.$$

The group C_3H_5 is here substituted for 3Ag, which are the atomic equivalents of 3H; thus the group C_3H_5, like the group PO, is triatomic.

The varied illustrations which we have given, and chosen designedly from mineral as well as organic chemistry, show us that there elements and groups possessing different atomicities; that is to say, that the various elements do not always replace each other atom for atom, nor the various groups molecule for molecule.

Fully comprehending the importance of this idea of the fact of double substitutions introduced by Dumas and Laurent, Gerhardt insisted that all chemical changes are double decompositions. This was going too far; there are simple substitutions. Thus, when we prepare hydrogen in the ordinary way, it is done by a simple substitution:

$$SO_4H_2 + Zn = SO_4Zn + H_2.$$

The molecule of zinc we know is not double; but the atom of zinc (=65) can exist alone and play the part of H_2.

The decomposition of sulphate of silver by hydrogen is another example of a simple substitution:

$$SO_4Ag_2 + H_2 = SO_4H_2 + Ag_2$$

In the explanation of all these reactions you have seen, gentlemen, that we have often introduced the word radicals; in an early lecture we shall indicate the exact meaning which we attach to this word.

NOTICES OF BOOKS.

First Outlines of a Dictionary of the Solubilities of Chemical Substances. By Frank H. Storer. Part III. London: Trübner and Co. Cambridge (U.S.): Sever and Francis. 1864.

The present part completes this valuable work, and we must highly commend the industry of the author who has brought it so quickly to a conclusion. The amount of reading which its compilation required must have been enormous, as will be seen by the innumerable references in its pages. But the author has bestowed more than mere literary labour on the work, for we occasionally come upon original experiments undertaken to reconcile or decide between the conflicting statements of different authorities, which give an additional value to the book.

The modest title which the author has given to the work may perhaps convey a false impression to a reader who sees only the title. Although denominated "First Outlines of a Dictionary," it is, in fact, exhaustive up to the date of publication. The number of "chemical substances" of which the solubilities are here given we have not had the patience to enumerate, but we may say that the work consists of 713 large octavo pages closely printed in double columns. Looking to the future, the author sees that the number of chemical substances may be indefinitely extended, and thus the work which he has planned, and so far so successfully completed, will in progress of time become merely the outlines of a book, the size of which we are afraid to contemplate.

In a work of this kind, though so full of instruction, there is nothing to quote, and we must content ourselves with strongly recommending it. There is a class of books of which it is said that no library should be without them; and of this one we may say that it is pre-eminently one which should be found in the library of every practical chemist.

Journal für Praktische Chemie. October, 1864.

This journal opens with a paper by Dr. Winkler "*On a Volumetric Process for Estimating Cobalt in the presence of Nickel.*" The author first estimates the cobalt and nickel together, by Künzel's process; then adds to another portion of the original solution (chlorides of the metals) some moist mercuric oxide, and afterwards a standard solution of permanganate of potash. Hydrated oxides of cobalt and manganese are precipitated, and the permanganate, of course, is decolorised. No change takes place with the nickel. The process is delicate enough to recognise one part of cobalt in 1000 of nickel. We shall give a detailed account of this method in an early number.

The next article is a description of an elaborate "*Analysis of one of the Homburg Springs,*" by Fresenius, which may be taken as a model for an analysis of the kind, although there is nothing new in the method. All the calculations for the combinations of the ingredients are given, which will make the article valuable to a student.

Another useful article is by Clasen "*On the Estimation of Tin and Antimony.*" The author has found Mr. Tookey's method does not give closely accurate results unless the amount of tin is greatly in excess of that of the antimony, in consequence ot the solution of some of the precipitated antimony in the acid. He therefore recommends that a weighed quantity of tin should be added and afterwards subtracted from the amount found in the analysis. The precipitation of the antimony should be effected by thin pianoforte wire, which leaves no weighable deposit on solution in hydrochloric acid. The precipitated antimony may then be washed with hot acidulated water, and quickly dried and weighed to avoid oxidation.

Reich and Richter contribute a farther account of "*Indium,*" which we shall translate, merely stating now that they have determined the atomic weight of the new metal to be (1) 463·4, (2) 458·4, (3) 464·9, O = 100. The methods employed seem to have been very rough, and the results are not very concordant.

The other papers in the *Journal* have already appeared in the Chemical News, with the exception of a notice of the methods of testing indigo, which shows that the oxidation processes are not to be relied upon.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2342. Alexander Horace Brandon, Rue Gaillon, Paris, "Improvements in machinery for refining petroleum and other oils." A communication from William Porter Downess, New York, U.S.A.—Petition recorded September 23, 1864.

2393. Coleman Defries, Houndsditch, London, "Improvements in lighting and ventilating."—Petition recorded September 2[illegible], 1864.

2409. Charles Godfrey Gumpel, Leicester Square, Middlesex, "Improvements in anatomical or surgical appliances for the support of parts of the human body."

2410. William Henry Gravely, Upper East Smithfield, Middlesex, "Improvements in steam machinery and sea-water distilling apparatus, all for use on board ship."

2411. Richard Archibald Brooman, Fleet Street, London, "Improvements in rendering soluble blue, violet, and red colours in crystals derived from aniline, toluidine, naptbaline, naphthylamine, and phenic acid."—A communication from Alcide François Poirrier, Montmorency, France.

2413. John Johnson, Runcorn, Cheshire, "Improvements in decomposing common salt with sulphuric acid in the manufacture of soda and muriatic acid."—Petitions recorded September 30, 1864.

2420. Edward Loysel, Park Place, Middlesex, "Improved apparatus for obtaining extracts from tea, coffee, and other vegetable substances."—Petition recorded October 1, 1864.

2428. Richard Archibald Brooman, Fleet Street, London, "The manufacture of a substitute for albumen."—A communication from Charles Kestner, Thann, France.—Petition recorded October 3, 1864.

2432. Richard Laming, Priory Road, Kilburn, Middlesex, "Improvements in making ammoniacal preparations."

2443. John Johnson and Thomas Johnson, Runcorn, Cheshire, "Improvements in purifying resin and resinous substances."—Petitions recorded October 4, 1864.

Notices to Proceed.

1387. Bondy Azulay, Rotherhithe, Surrey, "Improvements in treating petroleum and its products, and in the application of apparatus for that purpose."—Petition recorded June 4, 1864.

1409. Edward Joseph Hughes, Manchester, "Improvements in dyeing and printing."—A communication from Charles Lanth, Paris, France.—Petition recorded June [illegible], 1864.

1434. John Onions, Union Street, Southwark, "Improvements in the manufacture of iron and steel."

1438. Napoleon Sarony, Birmingham, Warwickshire, "Improvements in the production and treatment of photographic portraits or pictures."—Petitions recorded June 9, 1864.

1442. Josiah Pemberton Williams and Thomas Robinson, Widnes Dock, near Warrington, Lancashire, "Improvements in annealing wire."

1447. Charles William Siemens, Great George Street, Westminster, "Improvements in apparatus for producing combustible gases, part of which improvements are applicable for indicating the pressure of gases and fluids generally."—Petition recorded June 10, 1864.

1456. William Sharp, Bingley, Yorkshire, "Improved means, or apparatus for purifying and increasing the illuminating power of gas."—Petition recorded June 13, 1864.

2126. John Lones, West Bromwich, Staffordshire, "Improvements in coating iron with steel."—Petition recorded August 30, 1864.

2269. Charles Attwood, Tow Law Iron Works, Durham, "Improvements in blast furnaces."—Petition recorded September 16, 1864.

2316. George Scott, jun., St. Helens, Lancashire, and James Tudor, Weston, Cheshire, "Improvements connected with the manufacture of salt cake."—Petition recorded September 21, 1864.

2338. Walter Bentley Woodbury, Manchester, Lancashire, "An improved method of producing or obtaining, by the aid of photography, surfaces in 'relievo' and 'intaglio,' upon aluminous, vitreous, metallic, or other suitable materials."—Petition recorded September 23, 1864.

2364. Henry Beninson, Burrage Road, Plumstead, Kent, "Improvements in fluid meters."—Partly a communication from Frederick Arundel Downing, Hobart Town, Tasmania.—Petition recorded September 27, 1864.

CORRESPONDENCE.

On the Use of Sewage.

To the Editor of the Chemical News.

Sir,—Allow me to say a word or two on this subject. Having read Baron Liebig's letters bearing on this matter, I fully agree with the learned Baron on most points. I may, however, perhaps be allowed to have opinions of my own. It would appear that many chemists try to make out that our British farmers know little or nothing of the use of manures. I have no wish to appear as champion for any party, but I do believe that no sensible farmer—and there are many in our little island—would ever think of using sewage as a permanent manure. Surely it is not required of the farmer that he should make a profound analysis of sewage before using it. Has it not been used long before the important question of the use of sewage was brought so prominently before the public? I should imagine its properties are pretty well known by farmers ere this. There need be no fear that they will make a monopoly of it as a manure, and bring about such lamentable results as is feared. To bear out my views, look at the quantity of artificial manure that is made and sold in England every year.

When at Northampton some years ago, a gentleman by whom I was employed rented the sewage works of that town, and converted it into an artificial manure manufactory. All the sewage which came into the works from the town was made into various manures. It was not sent out in its original state, but at a trifling cost was made to suit almost all crops. Many hundred tons were disposed of to the farmers every season; and it answered in an extremely satisfactory manner. I merely mention this fact to show that sewage has been long before this brought to a good account—at one place, at any rate. I see no difficulty in doing what Baron Liebig puts forth in the last paragraph of his letter in the Chemical News of the 22nd instant. In fact, it has been done, to a certain extent, in the case above mentioned. I do not question any statement of the Baron's, but think the matter only requires more attention to enable our farmers to make a good use of sewage matter. I am, &c. J. H. S.

Bow, October 25.

MISCELLANEOUS.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following papers will be read:—"Isolation of the Electro-negative Radicle Valeryl," by Professor Wanklyn. "Existence of Nitrogen in Steel," by Messrs. Graham, Stuart, and Baker. "Concentration of Nickel in Lead by Pattinson's Process," by Mr. W. Baker. "Effect of Ignition on Garnets, &c.," and "Colouring Matter of Certain Rocks," by Professor Church.

University of Edinburgh.—In consequence of Dr. Playfair's absence from England, the information relative to the Chemical classes at the University of Edinburgh has only just reached us. As the Scottish schools open in November the information may still be of use to some reader. The course of instruction consists—

1. *Of Lectures.*—In the course of lectures the general subjects of theoretical chemistry, including a detailed description of elementary bodies and their compounds, are considered with especial reference to their useful applications to medicine and the industrial arts. The subjects of chemical physics are also fully discussed in their bearing on the general laws which govern the union of the different bodies. Examinations of the students, both oral and written, are frequently held. The Chief and Second Assistant conduct tutorial classes in connexion with the lectures, in order to discipline the student on the subjects treated of.

2. *Laboratory.*—The laboratory is open for the reception of pupils who desire to study analytical chemistry, or to undertake chemical investigations. The Hope prize of the annual value of £50, is awarded in four laboratory scholarships to the four most successful students of the general class. The fee for the laboratory is ten guineas for six months, or six guineas for three months. It is open during all the winter session, and for three months in the summer session. The Professor is aided in the laboratory by Mr. Dittmar as Chief Assistant.

3. *Practical Classes.*—The instruction in these is chiefly devoted to practice in qualitative analysis, with the view of enabling the student to test unknown substances, poisons, urine, &c. They are taught by the Demonstrator, Dr. Dalzell, under the superintendence of the Professor. The fee is three guineas.

Text-books.—Any of the following, viz.:—Fowne's Manual of Chemistry: Churchill, London. Gregory's Hand-book of Chemistry: Taylor and Walton, London. Miller's Elements of Chemistry. 3 vols. Parker and Sons, London.

The New Hydrocarbon Light.—In our previous account of Mr. Bowditch's invention we were obliged to omit all notice of the interesting lecture that gentleman delivered in explanation of his invention. In the course of it he referred to the ordinary constituents of common gas, and showed from Bunsen's analyses the great predominance of heat-producing over light-giving ingredients. Passing to a consideration of the nature of flame, he showed that the higher hydrocarbons generated from coal which give the maximum of light were excluded from gas by the fact of their assuming either the liquid or solid form at the ordinary temperature of the air. The object of his invention, he said, was to restore these hydrocarbons to the gas, and hence to obtain the maximum illuminating power, with the minimum of heat. The method by which the inventor vaporises naphthaline, &c., we explained in our previous notice. Mr. Bowditch conjectures that in a state of vapour and at a high temperature some chemical combinations take place between the several vapours and the constituents of the gas, combinations which break up again at a lower degree of heat. The grounds for this belief were not fully stated, and we may omit all notice of them for the present. With regard to the increase of illuminating power obtained, the extract from the prospectus we quoted last week considerably understated the results. The experiments made and verified by ourselves proved that the light given by gas passing through the carburetter at the rate of three feet per hour was eight times greater than the light given by ordinary gas burnt under precisely similar conditions at the rate of three and a-half feet per hour. It is only fair, however, to the gas companies to say that the burners employed in the experiments were not the most approved for obtaining the maximum light from poor gas like that supplied in London. But the great advantage of the invention is no less apparent since the light is obtained at so little cost.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E C.

A Subscriber.—We will inquire, and answer your question next week.

J. G. B.—We should not like to draw an inference from the experiment described.

P. C.—We do not know the process, but the acid is no doubt acetic, which only requires purification in the ordinary way.

Books Received.—Galloway's Qualitative Analysis, fourth edition: Elements of Materia Medica, by Dr. Wm. Fraser, second edition.

Received.—A. Reynolds, next week.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Revision of the Mineral Phosphates, by A. H. Church, *M.A. Oxon., Professor of Chemistry, Royal Agricultural College, Cirencester.*

No. III.—Prasine, &c.

A carefully selected sample of this mineral, from Libethen, Hungary, was finely ground, and then dried over oil of vitriol for five days. By this treatment 21·8 grains lost only ·03 of a grain. Submitted to analysis, prasine gave the following results:—

9·19 grains prasine gave 2·82 grains $Mg_2P_2O_7$.
9·19 „ „ „ 6·56 „ Cu_2O.
21·77 „ „ lost 1·92 „ H_2O (& CO_2) on ignition

These numbers, translated into percentages, are compared below with the theoretical percentages deduced from the formula $Cu_3PO_4,3CuHO$:—

	Theory—$Cu_3PO_4,3CuHO$.		Experiment.
Cu_2O . . .	238·5	70·87	71·16
P_2O_5 . . .	71·0	21·09	19·63
H_2O . . .	27·0	8·04	8·82
	336·5	100·00	99·61

The agreement of the experimental and theoretical numbers is not very close; experiment gave too little phosphoric anhydride and too much water. The cause of the discrepancy soon became apparent. Prasine contains variable quantities of malachite, the carbonic anhydride of which, at the same time that it lowers the percentage of P_2O_5, raises that of water as deduced from the loss sustained on ignition.* The percentage of CO_2 was ascertained by dissolving a considerable quantity of prasine in hydrochloric acid in Parnell's apparatus. From the loss of weight the percentage of carbonic anhydride was first calculated, and then from this the corresponding percentage of malachite. Some specimens of prasine contained more malachite than others; while, as a general rule, the paler and softer interior layers of a specimen contained more than the darker and harder outer crust. The percentages varied between 1·05 and 6·97. We must, then, regard prasine as chemically identical with phosphochalcite—remarking, however, that it usually occurs more or less mixed with malachite. It is possible that just as chrysocolla is silicated malachite, so prasine is phosphated malachite; the physical appearance of these minerals strongly confirms this view.

If malachite had not been a proved constituent of prasine, I should have felt inclined to assume the formula $2Cu_3PO_4,7CuHO$ for this mineral, since the percentage composition deduced from this formula approaches very nearly the experimental values, as the annexed numbers show:—

	Theory—$2Cu_3PO_4,7CuHO$.	Experiment.
Cu_2O . .	71·59	71·16
P_2O_5 . .	19·39	19·63
H_2O . .	9·02	9·21 (by difference)
	100·00	100·00

A Cornish mineral, apparently referable to phosphochalcite, was analysed by Heddle† in 1855. He, however, found too much phosphoric anhydride (22·73 per cent.), and too little cupric oxide (68·13 per cent.) He likewise found ·48 per cent. of silica.

Several other substances besides silica and malachite have been detected in specimens of phosphochalcite and the allied minerals. Bödecker‡ discovered selenium in some samples from Rheinbreitbach; Bergemann§ found arsenic (1·78 per cent. As_2O_5) in a phosphochalcite from Linz, on the Rhine; while in the allied mineral species ehlite he detected as much as 7·34 per cent. of vanadic anhydride.‖ But all the analyses point distinctly to the formula $Cu_3PO_4,3CuHO$ as representing the normal constitution of the mineral under consideration.

The formulæ of most of the allied mineral cupric phosphates are sufficiently well made out. The following list gives the names and formulæ of the more distinct kinds of these mixed phosphates and hydrates of copper. In all cases the analytical results obtained by the various chemists who have analysed them agree closely with the theoretical values, otherwise I should have thought it likely that the percentage of water in pseudolibethenite, ehlite, and perhaps in tagilite had been determined in specimens which had not been properly dried:—

Libethenite—$Cu_3PO_4,CuHO$.
Pseudolibethenite—$2Cu_3PO_4$,aq.,$2CuHO$, or (?)Cu_3PO_4,$CuHO$.
Tagilite—Cu_3PO_4, aq., $CuHO$, or (?)$Cu_3PO_4,CuHO$.
Dihydrite—$Cu_3PO_4,2CuHO$.
Ehlite—$2Cu_3PO_4$, aq., $4CuHO$, or (?)$Cu_3PO_4,2CuHO$.

Excluding the aq. in the three minerals I have named above, and introducing for comparison the formula of prasine and phosphochalcite, we obtain the following series:—

Cu_3PO_4, $CuHO$—Libethenite, pseudolibethenite, and tagilite.
$Cu_3PO_4,2CuHO$—Dihydrite, ehlite.
$Cu_3PO_4,3CuHO$—Prasine, phosphocalcite.

Not having been successful as yet in procuring satisfactory specimens of tagilite, &c., I have been unable to test further the soundness of the proposed formulæ, so far as regards the exclusion of the water. In one or two of the published analyses, the water, though probably determined by loss merely, was below that demanded by the old formula.

As to thrombolite, an amorphous mineral analysed by Plattner, its generally-received formula has merely to be re-arranged to become—

$$\left.\begin{matrix}Cu_4\\H_4\end{matrix}\right\}3PO_4,3aq.$$

Synthesis of Amylglycol by Oxygenated Water and Amylene.

Oxygenated water, in hydrochloric solution, as much concentrated as possible, reacts readily on amylene. This body disappears after a few weeks, if frequently shaken, and there remains a strong odour of hydrochlorate of oxide of amylene, which ether will remove from the liquid. If the liquid is then freed from hydrochloric acid by oxide of silver, and evaporated in a vacuum, there remains a thick liquid, with a pungent odour, which is amylglycol. In fact, treated by subchloride of sulphur, it is converted into hydrochlorate of oxide of amylene, which possesses the property and composition of this body. This experiment puts beyond doubt that oxygenated water can directly fix on carbides of hydrogen to form glycols or diacid alcohols.

$$\underbrace{C_5H_{10}}_{\text{Amylene.}} + H_2\Theta_2 = \underbrace{C_5H_{12}\Theta_2}_{\text{Amylglycol.}}$$

—*Annales de Chem. et de Phy.*, l. 492. 64.

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[*] Malachite contains 71·94 Cu_2O, 19·91 CO_2, and 8·15 H_2O per cent.

[†] *Phil. Mag.*, (4) x., 39.

[‡] *Ann. Ch. Pharm.*, xciv., 356.

[§] *Pogg. Ann.*, civ., 191.

[‖] *Jahrb. Min.*, 1858, 19.

On the Separation of Titanic Acid and Zirconia,
by M. F. Pisani.

The separation of titanic acid and zirconia is undoubtedly one of the greatest problems in analytical chemistry; in fact, the difficulties of all kinds by which it is surrounded are so great that no certain method has yet been found, in spite of the progress in modes of analysis for most chemical bodies; moreover, since Berzelius, all analytical treatises are unanimous in saying that absolutely nothing is known on this subject. Titanic acid and zircon, which separately may be estimated with the greatest accuracy, when together present such properties that it might be said one of these two bodies had partly destroyed the individuality of the other, since the reactions they possess when separate they no longer possess together, and in some cases they act quite different. Thus, it is well known that titanic acid in the state of sulphate is completely precipitated by boiling in a diluted liquid, and that when in presence of zircon there may, according to the proportions of the two bodies, be either incomplete precipitation or not at all. Moreover, precipitated titanic acid always retains zircon, of which the greater part remains in solution with the rest of the titanium. Not having been able, in spite of long researches, to effect the separation of these two bodies with sufficient accuracy, I found a way of independently estimating titanium, and so indirectly determining the zircon. The following is the foundation of this method:—

A solution of titanic acid in sulphuric or hydrochloric acid is reduced by zinc to the state of sesquioxide of titanium, giving a liquid of a more or less intense violet colour. In this state titanium is a very powerful reducer, On pouring permanganate of potash in this liquid, titanic acid is formed, and the solution gradually loses its colour until it becomes rose. According to the quantity of permanganate of potash it is found necessary to add may be calculated the quantity of titanic acid, taking for each equivalent of iron to which the permanganate corresponds one equivalent of titanic acid.* The following is the mode of operating:—

Titanic acid in solution in hydrochloric acid is best, because if in the state of sulphate it is liable to be partially precipitated by the rising of the temperature, before its complete reduction has been effected. In this case the sulphuric liquid should be precipitated by ammonia, the precipitate washed by decantation, and redissolved in hydrochloric acid. The reduction should be effected in a phial, to which has been adapted a cork with a drawn out tube, so as to keep the liquid from contact with the air. The quantity of liquid should not be great, and should be acidified until the disengagement of hydrogen becomes regular; then heat gently to accelerate the reduction, and when the colour of the liquid ceases to increase in intensity, leave it to get quite cold and dilute the liquid with cold water, which has been previously boiled to free it from air, as it would otherwise oxidise the titanium. As soon as the liquid is diluted decant it into a glass without taking the zinc with it, wash the flask once or twice, and then rapidly pour in the permanganate of potash.

Titanic Acid and Zircon.—First determine the weight of the two bodies, then after having attacked them by bisulphate of potash or sulphuric acid, estimate the titanium as above, the difference giving the quantity of zircon.

Titanic Acid and Iron.—The iron having been reduced by zinc before the titanium, and then reduced by the permanganate, I have adopted the following method of estimating these two metals at the same time. Pour permanganate upon them until the violet colour disappears, thus finding the moment at which the iron begins to oxidise in its turn by taking from time to time a drop of the liquid and mixing it with a drop of sulphocyanide of potassium in a porcelain capsule. When the sulpho-cyanide begins to be coloured the number of divisions used will give the quantity of titanic acid; the operation may then be continued for estimating the iron. Another method I have employed consists in reducing the iron by sulphuretted hydrogen or sulphite of soda, which does not act on the titanic acid, and then estimating the iron after having freed the liquid from the excess of sulphuretted hydrogen or sulphurous acid in the way usual in such cases. The difference gives the amount of titanium, but as the results often give too large a quantity of iron the first method is much preferable.

Titanic Acid, Zircon, and Iron.—Weigh the three bodies; attack them with bisulphate of potash, and estimate the titanic acid and the iron by means of the first method; the difference gives the amount of zircon.

A curious fact I have remarked is that if fluotitanate of potash or titanic acid is reduced by zinc in hydrochloric acid to which an alkaline fluoride has been added, the liquid is no longer violet, but greenish, probably because a sesquifluoride of titanium is then formed instead of a sesquichloride. However, the results of the estimation by permanganate are the same in this case.

The above will show how easy it is to estimate titanic acid mixed with zircon; also in most analyses in which titanic acid is precipitated by boiling, it may by this means be ascertained whether it is free from other bodies. When it contains zircon a second estimation of titanic acid is necessary in the liquids not precipitated by the boiling and containing the rest of the zircon with the other bases. For this it is necessary to separate the zircon, the titanic acid, and the iron, to weigh them together, then to determine the quantity of titanium and iron, the difference giving the amount of zircon.

I have used the following methods for ascertaining directly the presence of zircon when mixed with titanic acid:—

1st. A solution of zircon in hydrochloric acid colours tumeric paper orange, especially after it has been left to dry, and titanic acid under the same circumstances colours it brown, which prevents zircon from being recognised. I have overcome the difficulty by reducing the titanium by zinc, which in the state of sesquioxide does not colour tumeric paper, leaving the colour of the zircon to appear alone. Nevertheless, the paper must not be left too long to dry in the air, for the titanium, passing into the state of titanic acid, would in its turn colour it brown.

2nd. Titanic acid and zircon are precipitated equally by sulphate of potash; but if the titanium is previously reduced there remains only the zircon to be precipitated. Add excess of sulphate of potash to the violet liquid, which should be small in quantity and not too acid, the zinc being still slowly attacked meanwhile; leave to stand for some time, then filter quickly and wash the precipitate with a solution of sulphate of potash, then extract the zircon by the usual processes. Once in solution in hydrochloric acid its presence may be ascertained by means of turmeric, and by reducing by zinc it will be found that only a trace of titanium remains. I have not yet, however, succeeded in effecting this separation quantitatively.

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* The permanganate should be estimated by means of iron by Margueritte's process.

I have applied the same process to the estimation of titanic acid in molybdene, obtaining very exact results. With tungsten in niobium and vanadium my experiments have not at present been so satisfactory.—*Comptes Rendus*, lix., 298, 64.

On some Anomalies in the Detection of Sulphuric Acid, by JOHN SPILLER, *F.C.S.*

WHILST making an analytical examination of several samples of commercial phosphoric acid, I have been led to the discovery of a remarkable case of interference which appears to have hitherto escaped observation.

On mixing an aqueous solution of glacial phosphoric acid with chloride of barium for the purpose of testing for sulphuric acid amongst the impurities likely to be present, I found that, although no immediate precipitate made its appearance, the solution became gradually turbid, and eventually a very distinct indication of the existence of sulphuric acid was observed. This anomaly led me to examine further the reaction in question, and by now mixing intentionally the sulphuric and phosphoric acids, the fact already alluded to became sufficiently apparent.

As the result of a few experiments upon this point, it was proved that, if to an aqueous solution of the glacial acid a small proportion of sulphuric acid be added, the mixed liquid did not give the usual indication of a precipitate on adding a few drops of chloride of barium, but required a liberal addition of the last-named reagent in order to induce the formation of the sulphate. By adding dilute hydrochloric acid, or by raising the temperature of the clear barytic solution, the formation of a precipitate was determined; but continued ebullition failed, in many instances, to separate the whole of the sulphate of baryta. When, however, by the action of heat and of hydrochloric acid conjointly, the white precipitate made its appearance, it was always found to be markedly different in physical character from the product usually obtained. It was thrown down in the form of a semi-transparent flocculent precipitate, very like that formerly obtained by me through the intervention of an alkaline citrate, as described in my paper entitled "On the Influence of Citric Acid on Chemical Reactions," which was read before the Chemical Society on March 16, 1857*.

This remarkable property of obscuring the indication of sulphuric acid appears to be possessed only by the glacial modification of phosphoric acid; for, if the white flakes of phosphoric anhydride (as obtained by the combustion of phosphorus) be dissolved in water, no such result is apparent; nor do the hydrochloric acid solutions of bone-ash and of the ordinary phosphate of soda mask, in any appreciable degree, the presence of sulphuric acid. But if by heat the ordinary crystals of phosphate of soda be converted into pyro-phosphate, and then dissolved in dilute hydrochloric acid, a solution is obtained which in this particular exactly resembles the glacial modification of phosphoric acid.

As in the case of the citrates, there appear to be several reactions which are altogether modified by the presence of the glacial acid. It is well known that many metallic oxides form combinations with phosphoric acid, which differ widely in character from the ordinary saline compounds of the same metals; iron, particularly, is in this category, and I find that the salts of lead, like those of barium, fail in giving any precipitate with diluted sulphuric acid, in which has been dissolved a fair proportion of the glacial phosphoric acid.

Chemical Department, Woolwich, October 25.

On Indium, by F. REICH *and* T. H. RICHTER.

A QUANTITY of black blende ore from the Himmelfahrt mine, weighing 200 lbs., on treatment with hydrochloric acid and subsequent evaporation gave about 43 lbs. of impure chloride of zinc, which, after treatment with water, left a residue containing indium, from which a few grammes of the new element were obtained. The metal can be reduced from the oxide by fusion in a carbon crucible with carbonate of soda and borax, and refusion with cyanide of potassium. By fusing with the cyanide alone the oxide is reduced, but only to a metallic powder. The density of two specimens, weighing respectively 327 and 343 milligrammes = 7·11 and 7·147; a rolled leaflet of 415 milligrammes gave a density of 7·277 at 20·4° Cent. The colour of the metal is between tin and silver white. It is exceedingly soft and very ductile, and retains its metallic lustre when exposed to the air or in water, even when boiled. The fusing point is about the same as that of lead. Hydrogen reduces the oxide to a metallic powder, which cannot be fused in the bulb tube. On charcoal before the blowpipe it fuses easily, colouring the flame blue, and covering the charcoal with a coating, which is dark yellow while hot and white when cold. This coating is volatilised with difficulty when treated directly with the blowpipe flame. The oxide imparts no colour to the fluxes; when fused with borax it gives a grey enamel; with salt of phosphorus and tin a grey pearl. The metal is slowly dissolved by hydrochloric and sulphuric acids when cold, with evolution of hydrogen; heat increases the rapidity of the solution. It dissolves rapidly in nitric acid, even when cold and diluted. The hydrated oxide is completely precipitated from the acid solutions by ammonia and potash; the presence of tartaric acid prevents this precipitation. A solution of the metal in nitric, sulphuric, or hydrochloric acids gives no precipitate with sulphuretted hydrogen; but when dissolved in acetic acid it is precipitated completely as sulphide of indium, which is of a fine yellow colour, that on drying becomes nut brown, and when pulverised an orange colour. The chloride is obtained by passing dry chlorine over the heated oxide. It is very volatile, and condenses in the cold part of the tube in white scaly crystals, which are easily resublimed, and in that way procured of a larger size. The aqueous solution of the chloride decomposes on evaporation hydrochloric acid, some chloride volatilising, and oxide or a basic chloride remaining behind. The sulphate crystallizes with difficulty in small white scales. Carbonate of soda throws down from acid solutions a crystalline granular carbonate of indium, of a white colour. Solutions of the neutral salts of indium give a white precipitate with ferrocyanide of potassium, but none with ferridcyanide. The most striking property of the new metal, and the one which led to its discovery, is the indigo blue line which it shows in the spectroscope. This is also given by all the compounds of the metal thus far investigated. The chloride gives the most brilliant effect, but the sulphide is the more lasting. Indium compounds colour the flame of an ordinary Bunsen's burner blue.

To determine the atomic weight the pure metal was dissolved in nitric acid, the oxide precipitated by ammonia, and weighed.

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* See also CHEMICAL NEWS, vol. viii., p. 280.

(1) 0·5135 of the metal gave 0·6243 of oxide, according to which In = 463·4[*].

(2) 0·699 of the metal gave 0·8515 of oxide, according to which In = 458·4[*].

We prefer the first determination, because the oxide in the latter was probably contaminated with iron.

From the solution of an unweighed quantity of well-washed, moist sulphide in nitric acid 0·2105 grm. of oxide of indium and 0·542 grm. of sulphate of baryta were obtained. This amount of sulphate of baryta corresponds to 0·0746 of sulphur, which gives (S = 200), In = 464·9.

We also endeavoured to determine the atomic weight by reducing the oxide in hydrogen; but the results were not sufficiently concordant to be useful. From the volatility of indium it might have been expected that the atomic weight obtained in this way would come out too low. That it always came out too high may be ascribed to the circumstance that the metal on fusing enveloped some oxide, and so prevented the reduction of the whole.

The method of extracting indium from the blende has been shortly described above, but a more detailed description may prove of service.

Finely powdered blende is dissolved in nitric acid and the solution treated with sulphuretted hydrogen. In this way copper, lead, arsenic, tin, cadmium, and molybdenum are precipitated, and then separated by filtration. The filtrate is afterwards treated with a large excess of ammonia, by which the greater part of the zinc is separated in solution, and oxide of indium and other metals precipitated. The washed precipitate is now dissolved in acetic acid, and this solution again treated with sulphuretted hydrogen, whereby sulphide of indium, contaminated with some sulphides of iron, zinc, and manganese, is thrown down. This precipitate is dissolved in hydrochloric acid with a little nitric acid, excess of ammonia is again added, and the precipitate rapidly filtered and washed. It is advisable to repeat this operation in order to remove the last traces of zinc and manganese. On dissolving this second precipitate in acetic acid, and treating the solution with sulphuretted hydrogen, a beautiful yellow precipitate of sulphide of indium is obtained, which, however, still contains some iron. To separate this, the sulphide is again dissolved in hydrochloric acid, the solution oxidised with nitric acid, and now, by the careful addition of ammonia or carbonate of soda, a small quantity of indium oxide and the iron may be thrown down. The filtrate from this precipitate on the further addition of ammonia yields pure hydrated oxide; or, if treated with carbonate of soda at a boiling heat, gives a pure carbonate of indium.

The above shows that a process for estimating indium in a blende quantitatively is still wanted. By the means described we only obtained 0·1 per cent. from the Himmelfahrt blende.

All the zinc from the blende we have examined shows the presence of indium, and it is more easy to separate the new metal from the zinc than from the blende itself.

TECHNICAL CHEMISTRY.

On the Extraction of Yellow from the Green Commercial Alizarine, by M. E. Kopp.

Green commercial alizarine, free from purpurine, is the only raw material which can be advantageously used for the preparation of yellow alizarine on a large scale. For this purpose it is only necessary to exhaust with hot alcohol or turpentine in a displacement apparatus, and to concentrate the alizaric solutions thus obtained. But the following process founded on the employment of schist or tar oil is, at the same time, simpler, easier, and more economical:—Boil dry green alizarine several times with purified schist oil, whose boiling point should be as near 150° C. as possible. As soon as the boiling ceases, the insoluble green matter readily collects and deposits itself. After a few minutes decant the hot schist oil, which will have dissolved a large proportion of yellow alizarine, a part of which, on the cooling of the liquid, is deposited in a crystalline state. As soon as the temperature of the oil is lowered to 100°, add a weak ley of caustic soda, and shake briskly. The ley dissolves all the alizarine, taking a bluish violet tinge, and the schist oil rises to the top, perfectly colourless, and ready, after decanting, to serve for another operation.

Draw off the lixivium charged with alizarine, and pour into it sulphuric acid diluted with water.

Yellow alizarine is immediately precipitated in voluminous flakes, which have merely to be collected on a filter, washed with cold water until all traces of acid have disappeared, and then dried.

The greenish-black matter, exhausted by several successive treatments with schist oil, and almost completely freed from alizarine, is left to drain in bags, and then pressed to expel most of the adhering oil, every trace of which is removed by exposure to the air or in a stove.

By treating it, when hot, with its weight of nitric acid, much diluted with water, it is transformed, with disengagement of carbonic acid and nitrous vapours, and the production of a little phtalic acid, into a yellow or brownish-yellow matter, very little soluble in water, very freely soluble in alkaline vapours, which it colours an intense vinous red, and which may be conveniently called xanthazarine.

Xanthazarine dyes wool and silk immediately, with or without a mordant; and also, but not so easily, cotton with a mordant. The tints are similar to those produced by yellow woods. Reducing bodies, such as sulphuretted hydrogen, stannous chloride, and hyposulphites, act energetically on xanthazarine, and transform it into a new red colouring matter.—*Comptes Rendus*, lix., 330. 64.

PHARMACY, TOXICOLOGY, &c.

On the Preparation of a Permanent Wine of Iron, by Harry Napier Draper *and* James Whitla.[†]

We have endeavoured to effect in a simple and practical manner an improvement upon the formula of the British Pharmacopœia for iron wine. The present formula is as follows:—

Take of tartrated iron . 160 grains.
„ sherry . . 1 pint. Dissolve.

It has been pointed out by Squiro that tartrated iron does not readily dissolve in sherry, which is already saturated with bitartrate of potash, and that, indeed, used in the above proportion, it will not all dissolve. We have not found this to be accurately the case. The potassio-tartrate readily dissolves in the wine, but part of it is almost at the same instant decomposed, forming a brown precipitate, which renders the solution thick and turbid. This decomposition is apparently due to the action of the bitartrate of potash contained in the wine and the separation of an acid tartrate of iron. If solution of potash be added to neutralisation, the precipitate is at once redissolved and the solution becomes clear. In a mixture of spirit and water of the same alcoholic strength as the wine, the tartrate dissolves without any trace of this decomposition.

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[*] O = 100.

[†] Read at the meeting of the Pharmaceutical Conference.

If, after solution of the tartrate, the wine be filtered, it will remain transparent for some time, but sooner or later it again invariably deposits, becoming turgid and unsightly.

In making these experiments it was soon observed that the action of solar light affected in a very marked degree the permanence of the preparation. Kept completely in the dark, the wine could be preserved for some time without precipitation, but if exposed to direct sunlight a deposit occurred in a few hours. In diffuse daylight the same change takes place more slowly. This is evidently due to the well-known deoxidising action of solar light upon organic salts of iron, and is not even, as regards the potassio-tartrate, an original observation, the fact having been pointed out more than twenty years since by Sir John Herschel (*vide* "Hunt's Manual of Photography," third edition, p. 54). By exposure to light an insoluble proto-tartrate is formed, and if the solar action be prolonged nearly the whole of the iron may be withdrawn from the solution. In attempting to produce a permanent iron wine several salts of iron were tried, but that which afforded the best results was the ammonio-citrate. A solution of this salt in sherry, in the proportion of one grain to each fluid drachm, is, in the first instance, perfectly transparent. If it be exposed to the light a precipitate is produced, as with the potassio-tartrate, but it is considerably less in quantity, and requires for its formation much more prolonged insolation. On the other hand, if excluded from light, the wine thus prepared will retain its transparency for an indefinite period.

A preparation, however, which required complete protection from light could scarcely be said to be permanent, and our next aim was to discover some means of overcoming this objection. As the precipitate had been ascertained to consist of a ferrous salt insoluble in the wine, it was evident that the addition of some substance which should prevent its precipitation by keeping it in solution would effect this purpose. After trial of several agents, we arrived at the conclusion that neutral citrate of ammonia was that best adapted to the requirements of the case. Many tentative experiments resulted in our being able to fix the proportion of this salt necessary to keep the wine transparent without imparting any disagreeable taste. The following formula affords a preparation which, in our opinion, leaves little to be desired:—

Ammonio-citrate of iron . 160 grains.
Crystalline citrate of ammonia 60 „
Sherry . . . . . 1 pint. Dissolve.

The wine thus prepared will, of course, contain in each fluid drachm one grain of ammonio-citrate of iron and three-eighth grain of citrate of ammonia. It is perfectly transparent, has no disagreeable taste whatever, and may be exposed to diffuse daylight without incurring the least liability to deposition, or indeed undergoing any apparent change, except that it becomes somewhat darker in colour after a time. This change in colour is, of course, produced by the reduction of the iron salt, the alkaline citrate not preventing the deoxidation, but simply keeping the proto-salt in solution. While, however, the alteration in tint cannot be considered of any practical importance, it may be quite prevented by keeping the wine in opaque vessels. The direct action of sunlight produces in this wine a precipitate after a considerable time, but this is a crucial test to which the preparation is not likely to be often subjected. However, if it were necessary to guard against even this cause of alteration, the increase of the proportion of citrate of ammonia would effectually do so, but it would be at the cost of rendering the wine somewhat unpalatable. Kept in an ordinary tincture bottle, and under the same conditions of light and temperature to which such preparations are usually exposed, a specimen prepared more than two months since remains without any sign of present or approaching alteration.

Dublin, September 12.

PHOTOGRAPHY.

Photographic Properties of some Haloids of Copper, by M. B. Renault.

In a previous note I described some properties of protochloride and of chloride of copper obtained by exposing copper wire to a disengagement of chlorine proceeding from a liquid capable of yielding this element. The analogy between the properties of chlorine, bromine, iodine, and next of fluorine and cyanogen, led me to investigate whether the four last bodies were not yet further allied, in the respect I have mentioned, to chlorine, in the analogous combinations which they might furnish with copper. The result of my experiments I will now give.

A copper plate plunged into a solution capable of yielding bromine, such as bromine dissolved in bromide of potassium, bibromide of copper, perbromide of iron, &c., becomes covered with a white crystalline layer, like that obtained in analogous cases with chlorine. This layer dissolves in chloride of sodium, is insoluble in chloride of potassium and chloride of barium; soluble in chloride of ammonium, ammonia, sulphate of ammonia, bromine dissolved in bromide of potassium, hyposulphite of soda, cyanide of potassium, diluted hydrochloric, sulphuric, and nitric acids (the corresponding chloride of copper is less easily dissolved in the two latter acids); insoluble in sulphite and sulphate of soda, and bromide of potassium.

Exposed to solar light*, the bromide alters rapidly, passes through all the tints of chloride, preserving, however, a more decided blue colour. Daguerreotype proofs may be obtained, with a finish limited only by that of the negative employed; the sensitiveness of bromide seems to be greater than that of the chloride. Moreover, the difference is more marked between the solubility of bromide altered by light and of unaltered bromide, in certain solvents. Thus hyposulphite of soda and chloride of sodium dissolve unaltered bromide, while diluted solutions of these reagents have very little effect on bromide blackened by the influence of the solar rays.† The operator must be on his guard against the fact that the solvent acting on unaltered bromide often takes with it, in a pulverulent but undissolved state, the layer of superficially altered bromide, and thus simulates a solution.

An insolated plate washed with distilled water gives no precipitate with ferrocyanide of potassium, but, like that which has been chlorised, becomes slightly turbid with nitrate of silver.

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* Diffused light also acts, but more slowly, on the bromide.

† Bromide of copper proofs may then be fixed in a similar way to that employed for photographic proofs.

Iodide of Copper.—A copper plate submitted to the action of iodine [‡] becomes covered with an equally white crystalline layer much less alterable by light than the corresponding chloride and bromide. After an hour or two of insolation, if the plate is dry, the outline of the negative is barely distinguishable. Under the same conditions chlorised and bromised plates alter extremely.

It is a remarkable peculiarity that if, after a proper period of insolation, the iodised plate is plunged into a solution, sufficiently diluted, of nitrate of binoxide of mercury, the non-insolated portions of the plate turn brick-red, while those, on the contrary, which have undergone the action of the light take the colour of protoiodide of mercury. This characteristic reaction, together with some considerations on the amount of electricity disengaged in the combination of copper with chlorine, bromine, iodine, and fluorine to obtain compounds sensitive to the light, will probably enable me to determine their composition.

Iodide of copper, altered by light or not, is insoluble in chloride of sodium, nitrate of potash, sulphite of soda, bromide of potassium, and chloride of ammonium, soluble in ammonia, hyposulphite of soda, cyanide of potassium, hydrochloric acid, diluted sulphuric and nitric acids, and sulphate of ammonia; altered iodide is rather less soluble in the last reagent.

Fluoride of Copper.—The solution most suitable in fluorising copper is the bifluoride of this metal. The plate, exposed to the light after having been attacked by fluorine, blackens and becomes violet-blue, like the chlorided plate, but more slowly. Before insolation, the plate is greyish-white, proving that the compound formed is not a protofluoride of copper.

Altered fluoride is very little soluble in hyposulphite of soda, chloride of sodium, diluted sulphuric and nitric acids, and sulphate of ammonia; soluble in diluted hydrochloric acid and in ammonia.

Unaltered fluoride dissolves in hyposulphite of soda, chloride of sodium, diluted sulphuric, nitric, and hydrochloric acids, and in ammonia, but is slightly soluble in sulphate of ammonia.—*Comptes Rendus*, lix., 558. 64.

PROCEEDINGS OF SOCIETIES.

The Chemistry of Gas Lighting, by Dr. LETHEBY.[§]

THE lecturer remarked that the object he had in view in the present instance was to take a rapid survey of the entire subject of the chemistry of gas manufacture. He did not intend to dwell particularly on any special set of facts; for although every branch of the subject was full of interest, and might well be made the basis of elaborate investigation, yet the time at his disposal would not permit of anything more than a general and very cursory examination of the whole question. He would endeavour, therefore, to gather up the broad principles of chemical knowledge in this department of industry, and indicate their directive tendency. He hoped at a future time to have the opportunity of examining in detail the several branches of the subject; and at the very commencement of the inquiry it would be interesting to know something of the origin of the material upon which, as gas manufacturers, they had to operate. The question which here suggested itself was—does chemistry throw any light upon the production of coal? There could be no doubt that it owed its origin to ligneous tissue; but how had it undergone those changes which had converted it into coal? Chemistry had pretty fully investigated this subject, and had shown that the production of coal was clearly traced to the Eremacausis, or slow combustion of ligneous tissue; and in looking at the modes of oxidation of woody matter, it would appear that there were three ways in which it could be, and no doubt was, effected. In the first place, it was partly effected by an internal change in the wood itself, whereby the elements—oxygen and hydrogen—associated and formed water, leaving the carbon free. In the second place, it was accomplished by the agency of water, the elements of which combined with carbon to form carbonic acid and marsh gas; and thirdly, it was effected by the action of atmospheric oxygen slowly carried to the woody tissue by percolating water. All these changes were illustrated by diagrams and by specimens of wood in every stage of change from lignite and Bovey coal to anthracite.

Formation of Coal.

Oak wood	$C_{36}H_{22}O_{22}$
Oak humus	$C_{36}H_{20}O_{20}$
Another ditto	$C_{34}H_{18}O_{18}$
Brown coal	$C_{33}H_{21}O_{16}$
Another ditto	$C_{32}H_{15}O_{9}$
Cannel coal	$C_{24}H_{13}O$
Caking ditto	$C_{20}H_{9}O$
Anthracite	$C_{16}H\ O$

It was scarcely within the province of the present lecture to enter upon a detailed inquiry as to the best kinds of coal for the manufacture of gas, and he did not propose to say more than that the coal must be of that description called bituminous. But it was a matter of considerable importance to know whether any particular coal would yield a fair average proportion of gas without submitting it to minute analysis. In referring, therefore, to the varieties of coal which were best suited for the manufacture of gas, he directed attention to the rough test whereby the value of the coal might be estimated; as, for example, the specific gravity of the specimen, which should be close to 1·3, and the loss encountered when a given quantity of the coal (say 100 grains) was ignited in a close vessel. The quality of the residue or the coke was also an indication of the value of the coal for gas purposes; and the lecturer exhibited a diagram of the average, the maximum, and the minimum amounts of coke and volatile matter in all the leading varieties of coal.

But there were certain impurities in coal which it became necessary to recognise. The three principal were ash or mineral matter, sulphur, and water, each of which had a very important influence on the manufacture of gas. The normal proportions of these impurities were illustrated by a series of diagrams of the compositions of various gas coals.

Composition of Gas Coals.

	Sulphur.	Ash.	Coke.	Volatile Mats.
Staffordshire—				
Maximum .	3·10	3·50	66·00	42·90
Minimum .	0·80	0·75	57·10	34·00
Average .	1·71	2·01	61·61	38·39
Lancashire—				
Maximum .	3·04	14·40	66·09	48·90
Minimum .	0·52	1·09	51·10	33·91
Average .	1·53	4·71	58·67	41·33
Newcastle—				
Maximum .	2·85	9·12	72·31	45·17
Minimum .	0·71	2·14	54·83	27·69
Average .	1·29	4·52	61·24	38·76
Scotch—				
Maximum .	1·58	8·05	59·15	45·06
Minimum .	0·38	1·96	54·94	40·85
Average .	1·22	5·46	57·32	42·68
Yorkshire—				
Maximum .	1·40	10·50	66·90	38·00
Minimum	0·75	0·80	62·00	33·10
Average .	1·19	2·96	64·37	35·63

[‡] The plate may be exposed to iodine vapours or to the action of a liquid capable of furnishing iodine; when it is moist the action is accelerated.

[§] Abstract of a lecture delivered at Manchester before the British Association of Gas Managers.

Welsh—	Sulphur.	Ash.	Coke.	Volatile Mats.
Maximum .	2·30	7·55	88·23	41·58
Minimum .	0·84	1·25	58·42	11·77
Average .	1·09	3·66	64·37	35·63

The modes of estimating these impurities were also referred to; and, in speaking of sulphur in coal, the lecturer alluded to the importance of making a selection of coals as free from it as possible, for Parliamentary legislation was manifestly towards the growing desire of the public to have gas with a minimum amount of sulphur. The means of determining the proportion of sulphur in coal were pointed out, and were illustrated by experiment. But, said the lecturer, there is another important question connected with this impurity in coal; in how many forms does it exist there; and of these, which are the most pernicious? He stated that it might, to a small extent, be there in a free state; and that of the combined forms it was perhaps associated with organic matter, as well as with iron (bisulphide of iron), and with lime as gypsum. The relative importance of each of these forms was dwelt upon, and he spoke of the pyritic form as the most objectionable, because of its giving off its sulphur at that temperature which is most favourable for the production of bisulphide of carbon and sulpho-hydro-carbons, both of which are unabsorbable impurities. The effect of moisture as an impurity was next referred to, and the lecturer explained how, when it was being distilled from the interior of a charge, and came into contact with the protosulphide of iron which had already parted with half of its sulphur, the aqueous vapour decomposed the sulphide, and formed sulphuretted hydrogen and oxide of iron, thus adding to the cost of the preparation.

The lecturer then directed attention to the facts which had been ascertained in respect of the temperature best suited for the destructive distillation of coal. He remarked generally that the action of heat on organic matters was to disturb the existing equilibrium of affinities, and thus to give the elements an opportunity of arranging themselves into other and simpler groups. The order of the movement of the molecules of organic matter when subjected to heat was somewhat as follows:—After the hygrometric or physical moisture had been dissipated, oxygen was the first to start in the race of thermotic change. It combined with hydrogen to form water, with carbon to form carbonic acid, and with carbon and hydrogen to form acid and spirituous compounds, comparatively rich in oxygen, and which were mixable with water. Next to move, perhaps, was the hydrogen in its combination with carbon to form solid and liquid hydrocarbons of the nature of paraffin and paraffin oil and benzole, which were not mixable with water. At a higher temperature the nitrogen combined with hydrogen to form ammonia, and with carbon and hydrogen to form pyrogenous alkaloids, and with carbon alone to produce cyanogen. At this temperature, also, the sulphur took hydrogen to form sulphuretted hydrogen, and then carbon and hydrogen to form the sulpho-carbo-hydrogens, and, lastly, with carbon alone to form bisulphide of carbon. Finally, gaseous hydrocarbons were freely produced; and during all the time of distillation many of the primary compounds, by coming into contact with the red-hot coke and with the sides of the retort, underwent change, and were converted into secondary products, as naphthaline, &c.

The temperatures at which these changes were effected had been tolerably well ascertained. Up to the temperature of 700° Fahr., little or no change was effected in the coal beyond the evolution of physical moisture. At the temperature of melting zinc (773° Fahr.), a little chemical moisture with an empyreumatic odour was produced. At 980°, which is a red heat just visible in the dark, water and fat oils—the paraffine series—begin to distil, but there is little or no gas. At 1500°, which is a cherry-red, gas of high illuminating power is copiously evolved, and spirituous oils rich in carbon also appear. At a full red heat (1800°), and from this to incipient whiteness, permanent gases of poor illuminating power, as carbonic oxide, marsh gas, and hydrogen, and pernicious sulphur compounds, are freely evolved. Practically, therefore, it may be said that the best temperature for distilling common gas coals is a cherry red (1500°), and for cannel coals a full red (1800°).

In illustration of the difference of the products when cannel coals are distilled at a high and low temperature, Dr. Letheby alluded to the quality of the tar in the two cases. The tar produced at a high temperature was always heavier than water—specific gravity ·12 to 1·15; it dried freely in the air by oxidation; it contained hydrocarbons with such an excess of carbon that they could not be burnt in a common lamp; they were almost totally destroyed by strong oil of vitriol; they contained sulphur; and their percentage composition was about 86 carbon, 7 hydrogen, 7 oxygen, and a little sulphur—about 0·5 per cent. Whereas the tar produced at a low temperature was lighter than water—about ·900 specific gravity; it would not oxidate or dry in the air; it contained hydrocarbons of the paraffin series, which are comparatively poor in carbon, and which can be burnt in a lamp; they are not much acted upon by strong oil of vitriol; they contain but little or no sulphur; and their percentage composition is about 84 carbon, hydrogen, and 4 oxygen. So also with the gases; at a temperature below 1800° they are rich in hydrocarbons of high illuminating power, and at a higher temperature they are comparatively poor in such hydrocarbons. The nature of the coal of course makes a large difference in the results, but the general expression of the fact is that high temperatures make a minimum quantity of tar, rich in carbon, and much gas with comparatively poor illuminating power, and with large proportions of sulphur compounds.

The raw gas as it leaves the retort, consists of aqueous vapour, vapour of tar, carbonic acid, carbonic oxide, ammonia, cyanogen, sulpho-cyanogen, sulphuretted hydrogen, bisulphide of carbon, sulpho-hydrocarbons, hydrogen, light carburetted hydrogen, olefiant gas, &c. Most of these are useless as illuminating agents, and therefore the necessity for purification. Fortunately, this, to a large extent, is easily effected by a natural process of condensation. As the gases and vapours cool, the condensable portions separate as liquid products, and thus in the hydraulic main and in the condensers the oily tar and the aqueous ammoniacal liquor separate of their own accord. The indications, therefore, of this first step of natural purification is to cool the raw gas as much as possible. But even when thus cooled it contains a large proportion of impurity which is soluble in water; and hence the next indication is the necessity for the use of a contrivance which shall bring the gas into contact with an aqueous solvent. Looking at the variable quality or composition of ammoniacal liquor, and that the proportion of ammonia in it ranges from about 1000 grains in the gallon to about 4000—or, in other words, that the saturating power of it per gallon is from about six ounces of the strongest sulphuric acid to twenty-six ounces—it is manifest that the best and proper washing liquid is ammoniacal liquor. This ought never to leave the gas-works with less than 2000 grains of ammonia in it per gallon, or with a less saturating power than thirteen ounces of sulphuric acid. There is no reason, indeed, why it should not always contain nearly double this quantity of ammonia. The use, therefore, of ammoniacal liquor as a washer of the raw gas is a natural inference. It was first suggested by Mr. Hawksley, and he has put it into practice with excellent effect, for not only does the ammoniacal liquor afford a means of removing ammonia, sulphuretted hydrogen, and carbonic acid from the raw gas, but being already saturated with hydrocarbons, it does not take up any more of these illuminating agents; besides which it can be used as a *douche* in such quantity in a large washer that it operates very successfully as a cooling agent. The suggestions, indeed, of Mr. Laming, that every charge of ammoniacal liquor thus used might be first filtered through hydrated oxide of iron, so as to remove the sulphuretted hydrogen, and thus give it a more effective purifying power, is not without practical value. But even when the gas has been thus cooled, and has left the condensers, it is not so free from ammonia, carbonic acid, and sulphuretted hydrogen as that a small quantity of water properly distributed in a scrubber will not still further purify it; and the arrangement should be such that the water should trickle very slowly over a large surface, and reach the bottom of the scrubber almost saturated with the impurities. Leaving this part of the apparatus, the raw gas should never contain more than 1 volume in a 1000 of ammonia, 8 of sulphuretted hydrogen, and 20 of carbonic acid. These are in the proportion of 315 grains of ammonia, 5048 grains of sulphuretted hydrogen, and 16,336 grains of carbonic acid in 1000 cubic feet of gas. Then comes the chemical means whereby these can be best removed, and this involves an inquiry into the action of the purifiers, as they are called.

The order in which these impurities should be taken out is a matter of no slight importance. Chemistry teaches us that the first impurity to be removed is ammonia, for its presence checks the withdrawal of carbonic acid and sulphuretted hydrogen. Among the many suggestions which have been made for the absorption of ammonia there is none so effective as diluted sulphuric acid, and it is found that 49 parts by weight of the strongest sulphuric acid will remove 17 of ammonia. It will take, therefore, 909 grains, or rather more than 2 oz., of sulphuric acid to remove the ammonia from the 1000 cubic feet of gas. The acid is best used diluted with about its own bulk of water and sprinkled upon sawdust, which should be placed first in the trays of the purifiers; and the sawdust thus saturated with the ammonia is a valuable material, as it should contain fully half its weight of sulphate of ammonia. Other valuable absorbing agents have been proposed, as the spent acids of various manufacturing processes, the acid salt of alumina obtained by boiling clay shale with sulphuric acid (Croll), and the residual chloride of manganese from bleaching works. This has recently been used by Mr. Croll in the form of a nearly dry mixture with sawdust, and it yields a salt of ammonia remarkably free from impurities.

Next after the ammonia it is proper to remove the sulphuretted hydrogen, and unquestionably, if no sanitary considerations are concerned, the best agent for this purpose is wet lime—a material which will not only remove the sulphuretted hydrogen, but will likewise absorb the carbonic acid. Theoretically, 28 parts by weight of lime will take up 17 of sulphuretted hydrogen, and another 28 parts will take up 22 of carbonic acid. It follows, therefore, that about 3 lbs. of lime will absorb the carbonic acid, and 1¼lb. the sulphuretted hydrogen in the 1000 cubic feet of gas—taking altogether about 42½ lbs. of lime for 10,000 cubic feet of gas. But this is on the supposition that the lime is thoroughly effective, and that it is used in a very wet state; practically it is not so completely effective, and hence it takes about 50 lbs. of wet lime to purify 10,000 cubic feet of gas. If the lime is used in the dry state (as a hydrate) it is by no means so effective, for it requires fully twice the quantity of lime to purify the gas. This is due to the circumstance that the interior of the little lumps of lime is never reached by the gas, and therefore remains inoperative; besides which the lime is constantly getting drier in the purifiers by the heat of combination with the impurities of the gas, and as the lime dries it loses its capacity for absorbing these impurities; absolutely dry lime, in fact, will scarcely absorb sulphuretted hydrogen.

The offensive nature of spent lime, or blue billy, is such that a demand has been made on science to furnish a less objectionable means of purification; and hence the use of the hydrated oxide of iron—a material which, when tolerably pure, will absorb sulphuretted hydrogen in the proportion of 17 parts of sulphuretted hydrogen to about 33 of the oxide. It will take, therefore, about 14 lbs. of the hydrated oxide to remove the sulphuretted hydrogen from 10,000 cubic feet of gas. It has then become a sulphide of iron, and has lost its power of purification, and must be revived. This is accomplished by simply exposing the oxide to the air, when it takes in atmospheric oxygen, and again passes into the state of hydrated oxide of iron, while the sulphur is set free in the mixture. The oxide thus charged is then used again and again, until it becomes charged to the extent of about 57 per cent. of sulphur, when it is no longer effective. Practically, a ton of oxide will, by successive revivification, purify about five millions of cubic feet of gas, and will absorb about 3600 lbs. of sulphuretted hydrogen. When thus charged with sulphur, it is valuable for manufacturing oil of vitriol.

If hydrated oxide of iron has been used as the purifier, lime must also be afterwards employed for the purpose of removing the carbonic acid, which is so destructive of the light of the gas when it is burned.

Having left the purifiers, the constituents of the gas are as follows:—

Hydrogen	25	to	50	per cent.
Light carburetted hydrogen, C_2H_4	35	„	52	„
Olefiant gas, C_4H_4	3	„	20	„
Propylene, C_6H_6				
Butylene, C_8H_8				
Other hydrocarbons, C_nH_n				
Benzole vapour, $C_{12}H_6$				
Acetylene, C_4H_2				
Carbonic oxide CO	5	„	9	„
Carbonic acid, CO_2	0	„	2	„
Cyanogen, C_2N	?		?	
Ammonia, NH_3	0·01	„	0·06	„
Bisulphide of carbon, CS_2	?		?	
Sulpho-hydrocarbons	?		?	
Aqueous vapour	2	„	3	„
Oxygen	0	„	1	„
Nitrogen	0	„	8	„

The properties of each of these constituents were demonstrated by experiment, and reference was made to their specific gravities, to their combining volumes, to the proportion of oxygen which they required for combustion, to the quantity of carbonic acid so produced, to the heat evolved, and to the action of water, chlorine, bromine, and anhydrous sulphuric acid upon them.

One of the interesting features of this part of the lecture was the production of acetylide of copper from the coal gas of the hall, and the exhibition of acetylene in large volume; as also the production of nitrobenzole from the gas, by passing it through fuming nitric acid.

As regards the means of determining the proportions of the condensable hydrocarbons in coal gas, Dr. Letheby showed that, as all the illuminating constituents of coal gas, excepting the light carburetted hydrogen, were absorbed by bromine and by anhydrous sulphuric acid, neither of these tests were worth anything as an indication of the illuminating power of the gas. In speaking of acetylene, he alluded to the fact that its production by the intense ignition of carbon in hydrogen was a remarkable example of the production of a hydrocarbon by the immediate combination of its elements; and he observed that as acetylene, which is such a powerful illuminating agent, may be made by the action of carbonic oxide on light carburetted hydrogen at high temperatures, it is possible that hereafter it will be found that by a proper arrangement of apparatus a high temperature may be best suited for the production of illuminating gas. The sole difficulty, perhaps, to be overcome will be the formation of carbonic oxide and marsh gas in proper proportions.

With respect to the existence of sulphur compounds in coal gas, Dr. Letheby demonstrated by many experiments that sulphide of carbon and one or more sulpho-hydrocarbons were always present; and he showed the patented processes of Mr. Bowditch, Dr. Stenhouse, and Dr. Angus Smith, for removing these sulphur compounds. He referred also to his own apparatus for estimating the amount of sulphur in purified coal gas; and be likewise explained the means of determining the proportion of ammonia in gas, and he spoke of this impurity as a purveyor of the offensive tar-like hydrocarbons.

A slight reference was made to the subject of coal tar, and to the large field of chemical research which it had exposed to the chemist; and a few of the more interesting of the coal tar pigments were made, and nearly all the products were exhibited on the table.

PRINCIPAL CONSTITUENTS OF COAL TAR.

Acids.

	Formulæ.	Boiling-points. Fahr.
Acetic	$C_4H_4O_4$	248°
Butylic	$C_8H_8O_4$	315°
Phenic	$C_{12}H_6O_2$	370°
Cresylic	$C_{14}H_8O_2$	397°
Phlorylic	$C_{16}H_{10}O_2$	—
Rosolic	$C_{24}H_{12}O_6$	—
Brunolic	?	—

Neutral.

	Formulæ.	Boiling-points. Fahr.
Propylene	C_6H_6	—
Butylene	C_8H_8	54°
Amylene	$C_{10}H_{10}$	102°
Caproylene	$C_{12}H_{12}$	131°
Alliaceous	?	?
Benzole	$C_{12}H_6$	176°
Toluole	$C_{14}H_8$	237°
Xylole	$C_{16}H_{10}$	259°
Cumole	$C_{18}H_{12}$	302°
Cymole	$C_{20}H_{14}$	347°
Naphthaline	$C_{20}H_8$	414°
Anthracene	$C_{28}H_{10}$	—
Paraffine	C_nH_n	—
Pyrene	$C_{10}H_4$	—
Chrysene	$C_{12}H_4$	—

Alkalies.

	Formulæ.	Boiling-points. Fahr.
Ammonia	H_3N	—
Methylamine	C_2H_5N	—
Ethylamine	C_4H_7N	66°
Petinine	?	176°
Cespitine	$C_{10}H_{13}N$	205°
Pyrrhidine	$C_{10}H_5N$	271°
Picoline	$C_{12}H_7N$	273°
Lutidine	$C_{14}H_9N$	309°
Collidine	$C_{16}H_{11}N$	338°
Aniline	$C_{12}H_7N$	360°
Parvoline	$C_{18}H_{13}N$	370°
Toluidine	$C_{14}H_9N$	388°
Coridine	$C_{20}H_{15}N$	412°
Xylidine	$C_{16}H_{11}N$	415°
Cumidine	$C_{18}H_{13}N$	437°
Rubidine	$C_{22}H_{17}N$	446°
Cryptidine	$C_{22}H_{11}N$	—
Leucoline	$C_{18}H_7N$	455°
Cymidine	?	462°
Viridine	$C_{24}H_{19}N$	484°

Lastly, in respect of the chemistry of the combustion of gas, Dr. Letheby showed under what circumstances it was best consumed, and he demonstrated in various ways, as by Erdmann's gas-prover, that the proper illuminating power of coal gas could only be obtained by an accurate adjustment of the air to the gas. This was chiefly accomplished in the Argand burner by a proper adaptation of the internal aperture to the quality of the gas—a burner of only 0·42 of an inch internal bore was well suited for 11-candle gas, one of 0·44 of an inch for 13-candle gas, and one of 0·50 of an inch for 15-candle. In each of these cases the burner is used without a gauze diaphragm, and with a 7-inch chimney, the gas being burned at the rate of 5 feet an hour; but the same result and a steadier flame is obtained by using Sugg's burner of a little smaller diameter of the internal hole in each case, and a gauze diaphragm. By experiment with Leslie's burner, which is altogether unsuited for gas of low illuminating power, it was shown that the light of the gas might be seriously destroyed.

The relative values of different illuminating agents were shown by the following table:—

Relative Values of Illuminating Agents in respect of their Heating and Vitiating Effects on the Atmosphere, when burning so as to give the Light of Twelve Standard Sperm Candles.

	Pounds of Water heated to 1° Fahr.	Oxygen consumed (cub. ft.).	Carbonic acid produced (cub. ft.).	Air vitiated (cub. ft.)
Cannel gas	1950	3·30	2·01	50·2
Common ditto	2786	5·45	3·21	80·2
Sperm oil	2335	4·75	3·33	83·3
Benzole	2326	4·46	3·54	88·5
Paraffin	3619	6·81	4·50	112·5
Camphine	3251	6·65	4·77	119·2
Wax candles	3831	8·41	5·90	149·5
Sperm ditto	3517	7·57	5·27	131·7
Stearic ditto	3747	8·82	6·25	156·2
Tallow ditto	5054	12·06	8·73	218·3

In conclusion, the lecturer observed that every day brought to light some new fact connected with the chemistry of gas manufacture, which deserved the careful consideration of all who, like those to whom he was addressing himself, were practically engaged in this important branch of industry. He had endeavoured to lay before them, with as much fulness as time allowed, the most prominent features of the question, as far as the light of science had at present elucidated them; but the subject, in all its details, was far too complex to allow of more than a mere general statement in the compass of a single lecture.

ACADEMY OF SCIENCES.

October 17.

Our usual report of the French Academy was by accident omitted last week. At the last sitting but one, M. Kuhlmann continued his memoir "*On the Crystallogenic Force.*" In this part he refers to some simple matters well known to most of our readers; we mean the crystallisation on glass of saline solutions, thickened with gum. Sulphate of magnesia is generally used by barbers and others who ornament their windows in this way, but M. Kuhlmann states that the prettiest effects are obtained with a solution of sulphate of zinc, and he points out how the appearance may be improved by painting over the crystallisation with an alcoholic solution of some colouring matter such as fuchsine. Beautiful as some of these crystallisations are, we all know that they are very unstable, and M. Kuhlmann tried various varnishes with the hope of perpetuating the appearances. None of them however, answered, and at last he thought of copying them by photography. With Mr. Bingham's assistance he obtained some beautiful pictures on collodion plates, and also copied the crystallisations directly upon paper. Very pretty pictures, too, it seems can be obtained for the stereoscope. M. Kuhlmann also tried the galvano-plastic method of reproducing his crystalline pictures, so as to be able to print them upon paper or fabrics. For this purpose he obtained the crystallisation upon a thin plate of copper, and copied it by passing this plate on another through a powerful rolling machine. The forms were beautifully preserved, notwithstanding the great pressure, and the plates could be used for printing as soon as they came from the rollers. M. Kuhlmann suggests that the designs may also be copied by pressing gutta percha on glass plates covered with the crystals. The gutta-percha moulds may then be copied by the electrotype process. It was suggested that this style of ornamentation might be substituted for ordinary chasing on articles of gold and silver, and a specimen so ornamented was exhibited to the Academy. M. Kuhlmann gave some idea how a continuous picture might be obtained by procuring the crystallisations on one cylinder of copper and transferring them to another cylinder, but technical details on this point are still wanting. The author lastly pointed out that no two crystallisations are obtained exactly alike. They can only be copied by photography, for the fineness of the designs would defy the burin of the most clever engraver; he therefore suggests that the designs would be useful for bank notes. Copper plates might be obtained in the way described, and if the design were printed in pale blue ink on a bright yellow ground, the photographer and the engraver would both be defeated in obtaining a counterfeit.

M. Scheurer-Kestner presented an additional note "*On Leblanc's Process.*" The author has now settled the reactions which take place in the formation of black ash, and he thus expresses them:—The reactions pass through three phases: in the first, sulphate of sodium is reduced to sulphide, carbonic acid being given off—

$$5\text{Na}_2\text{ꞨƟ}_4 + 10\text{Ꞓ} = 5\text{Na}_2\text{Ꞩ} + 10\text{ꞒƟ}_2;$$

then a double decomposition takes place between the sulphide of sodium and carbonate of calcium—

$$5\text{Na}_2\text{Ꞩ} + 5\text{ꞒaꞒƟ}_3 = 5\text{Na}_2\text{ꞒƟ}_3 + 5\text{ꞒaꞨ};$$

lastly, a partial reduction of the carbonate of calcium employed in excess is effected by the carbon, carbonic oxide being disengaged—$2\text{ꞒaꞒƟ}_3 + 2\text{C} = 2\text{ꞒaƟ} + 4\text{ꞒƟ}$. This reduction is arrested by the cooling of the mass.

The theoretical quantity of carbon required for these reactions rises from 16·8 to 20·2 for 100 parts of sulphate of sodium.

The addition of an excess of chalk, then, is doubly useful. It seems to replace that portion which is reduced to oxide in the course of the operation, and it allows us to see the exact moment at which the reaction is terminated, for the mixture must be drawn from the furnace after the disengagement of carbonic oxide has begun, and before the evolution of the gas has ceased.

October 24.

At this sitting, M. S. Meunier presented a note entitled "*Contributions to the History of Sulphur and Iodine.*" The object of the author was to explain two singular facts observed by Diezenbacher, namely, that a small proportion of iodine fused with sulphur at 180° gave lasting plasticity to the sulphur, and also that the action of iodine rendered the sulphur completely insoluble in bisulphide of carbon. Iodine fuses at 107°, and sulphur about 110°; but a mixture of one part of iodine and ten parts of sulphur becomes liquid between 92° and 95°. A mixture of seventy parts of iodine and one of sulphur becomes pasty about 95°. The reason of this, according to the author, is that at a moderate temperature the mixture is converted into a compound of iodine and sulphide of iodine. The sulphide of iodine, IS_2, fuses at 90°, and, if slowly cooled, remains soft for a time, and a small proportion of the compound fused with a large excess of sulphur had the effect of rendering the latter soft and insoluble. M Meunier found that bisulphide of carbon completely separated the two elements. The author accounts for the fact that one part of iodine will render 400 parts of sulphur insoluble by supposing that at a high temperature the iodine combines successively with every molecule of the sulphur, the compound being destroyed by the increasing heat, and in the end the whole of the iodine vaporised, the vapour, as it traversed the mass, having changed the molecular state of the sulphur. The author quotes a singular fact observed by Peligot, who found that the totally insoluble sesquichloride of chromium was instantly rendered soluble by the addition of $\frac{1}{10000}$th of the soluble protochloride.

M. Hautefeuille made a communication "*On the Artificial Production of Sphene and Perowskite,*" two titanium minerals of no great interest.

MM. Bussy and Buignet gave an account of the results of a long series of experiments "*On the Changes of Temperature produced in Mixtures of different Liquids.*" The authors experimented principally with volatile liquids, such as ether, alcohol, chloroform, and bisulphide of carbon. Their paper was long and interesting, but we have only space for the conclusions to which their experiments led them:—

1. When two liquids which dissolve in each other in all proportions are mixed, some change of temperature always occurs; sometimes it rises, and sometimes it falls.

2. This effect is the consequence of two causes—either *affinity* between heterogeneous molecules which produce heat, or *diffusion*, which consists in the movement of homogeneous molecules, in order to be distributed through the mass, and which produces cold.

3. When the two liquids mixed have but a weak affinity for each other the effects of diffusion become sensible, and produce a fall of temperature.

4. The rise or fall of temperature does not entirely depend on the nature of the liquids; it varies for the same mixture according to the relative proportions of the liquids.

5. The influence of the relative proportions may completely alter the thermometric effect; 5 of alcohol with 1 of chloroform cause the thermometer to rise 4°·5; on the contrary, 5 of chloroform with 1 of alcohol cause a fall of 2°·6.

6. The initial temperature of the liquids when mixed have a sensible effect on the result in general; the fall is more marked when the initial temperature is high.

7. Liquids undergo a change of volume as well as of temperature when mixed. Sometimes there is dilatation, as with alcohol and sulphide of carbon; sometimes there is contraction, as with alcohol and ether.

8. There is no apparent relation between the changes of temperature and volume; some mixtures which contract produce heat, while others which also contract produce cold.

A short discussion followed, in the course of which M. Pasteur characteristically introduced the subject of fermentations, decompositions, in the course of which heat is evolved. These phenomena, he said, may be regarded as slow explosions.

NOTICES OF BOOKS.

Annales de Chimie et de Physique. September, 186.

In this journal we have a long paper by M. Marignac "*On the Silico-tungstic Acids,*" with a note on the constitution of "*Tungstic Acid.*" We gave some account of these acids when the author first communicated his researches to the Academy of Sciences. [See Chemical News, vol. ix., pp. 230, 279.] The present communication is mainly occupied with a description of the alkaline salts of the acids mentioned in the former paper. In the note on the constitution of tungstic acid the author gives his reasons for adopting the view of Persoz, who regards the formula WO_3 as most probably correct for tungstic acid.

M. Marignac's paper is followed by the second part of an important communication "*On the Mechanical Theory of Heat,*" by M. Dupré. It is a profound mathematical paper, and we can only transcribe the title.

The only other article is a translation of Mr. Graham's paper "*On the Properties of Silicic and other Colloid Acids,*" which has appeared in the Chemical News.

Bulletin de la Société Chimique de Paris, &c. October, 1864.

THE papers read before the Chemical Society of Paris have for the most part been previously communicated to the Academy of Sciences, and are consequently noticed in our reports of the proceedings of that learned body. Such has been the case with the leading papers in this number of the *Bulletin*.

From the analyses of articles on pure and applied chemistry published with the proceedings of the Paris Society we often borrow; but in the present instance all the papers of interest have already appeared in our pages.

Chemisches Central-blatt. October 26, 1864.

FOR the future we shall add the contents of this useful periodical to our notices of foreign journals. The remark we have made above on the contents of the Journal of the Chemical Society of Paris will apply to this number of the *Central-blatt*, which offers little of interest which has not appeared in the CHEMICAL NEWS.

NOTICES OF PATENTS.

Communicated by MR. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2460. Benedict Margulies, Trieste, Austria, now residing at St. Helens, Lancashire, and John Knowles Leather, of the same place, "Improvements in the manufacture of salts of chromium."

2465. Peter Armand Le Comte de Fontainemorean, Rue de la Fidélité, Paris, France, and South Street, Finsbury, London, "Certain improvements in photography for obtaining images direct on cloth and other materials."—A communication from Jean Nicholas Truchelut, Rue de Grenelle, St. Honore, Paris, France.—Petition recorded October 6, 1864.

2468. Thomas Parkins, Robert Town, near Normanton, Yorkshire, "Improvements in apparatus used in the manufacture of prussiates of potash."

2472. George Haseltine, Southampton Buildings, Chancery Lane, Middlesex, "An improved process for purifying coal and ores."—A communication from Benjamin Franklin Penniman, city, county, and state of New York, U.S.A.

2475. Thomas Kenyon, the younger, Miles Platting, Manchester, Lancashire, "Improvements in preparing, fixing, and mordanting cloth and yarns."—Petitions recorded October 7, 1864.

2487. John Cassell, La Belle Sauvage Yard, London, "Improvements in treating coal, peat, shale, wood, and ligneous products, and in obtaining fuel, oil, and other products therefrom."—Petition recorded October 10, 1864.

2504. Hiram Tucker, Newton, Middlesex, Massachusetts, U.S.A., "An improved process for bronze-colouring iron."

2506. William Edward Newton, Chancery Lane, Middlesex, "Improvements in the manufacture of ink."—A communication from Josiah Vincent Lavers, Sydney, New South Wales.

2510. Frederick Wilkins, of Oxford Street and Regent Street, Middlesex, "Improvements in apparatus for the production of hydrocarbon vapour, and for the application of the same to illuminating or heating purposes."—Petitions recorded October 11, 1864.

2525. John Watson, Lombard House, George Yard, London, F.G.S., "Improvements in the manufacture of hydrocarbons."—Petition recorded October 13, 1864.

2533. William Robert Sykes, Pimlico, Middlesex, "Improvements in apparatus for transmitting positive and negative currents of electricity."

2535. Joseph Watts, Coventry, Warwickshire, "Improvements in apparatus for conducting the fermentation of wort and other fermentable liquids."—Petitions recorded October 14, 1864.

2559. Alfred Hill, Birmingham, Warwickshire, "Improvements in privies, dry closets, and commodes, and in deodorising substances to be used in privies, dry closets, and commodes."—Petition recorded October 17, 1864.

2573. Nathan Thompson, Abbey Gardens, St. John's Wood, Middlesex, "Improvements in stoppers for bottles, jars, and other vessels, and in stoppers for the muzzles of firearms."—Petition recorded October 18, 1864.

Notices to Proceed.

1452. Peter Spence, Newton Heath, Lancashire, and John Berger Spence, of the same place, "Improvements in calcining and smelting copper ores."—Petition recorded June 11, 1864.

1498. George Hyacinthe Ozonp, Rua Sainte Appoline, Paris, France, "Improvements in the manufacture and utilisation of carbonic acid, and in apparatus connected therewith."—Petition recorded June 16, 1864.

1513. William Henry Tooth, of Rhodeswell Road, Stepney, Middlesex, "Improvements in furnaces or apparatus for generating carburetted hydrogen, carbonic acid, carbonic oxide, and cyanogen gases."

1514. William Henry Tooth, Rhodeswell Road, Stepney, Middlesex, "Improvements in the manufacture and refining of iron, and in the manufacture of steel."—Petitions recorded June 17, 1864.

1523. Richard Jones, Botolph Lane, Eastcheap, "An improved method of preserving animal and vegetable substances."—Petition recorded June 20, 1864.

1538. William John Pughsley, Christchurch, Monmouthshire, "Improvements in obtaining sulphuric acid from the refuse 'pickle' used in tin-plate works, and also from sulphate of iron or green copperas."—Petition recorded June 21, 1864.

1561. John Jones, New North Road, Middlesex, "Improvements in dry gas-meters, parts of which are applicable to apparatus for regulating the flow of air."—Petition recorded June 22, 1864.

2018. Edward Andries, Schaerbeck, near Brussels, Belgium, "Improvements in means or apparatus for purifying every kind of water, and rendering it drinkable, and for rendering sea water fresh and drinkable."—Petition recorded August 23, 1864.

2175. John Knowles Leather, St. Helens, Lancashire, "Improvements in the manufacture of salts of chromium from chrome ore."—A communication from Benedict Margulies, Trieste, Austria.—Petition recorded September 6, 1864.

2443. John Johnson and Thomas Johnson, Runcorn, Cheshire, "Improvements in purifying resin and resinous substances."—Petition recorded October 4, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, October 28.

THERE is rather a dearth of scientific news just now in Paris. We are waiting for the "season," which will soon set in, and no doubt furnish plenty of materials for gossiping letters. In the meantime I may call attention to one or two industrial novelties—one of which may, perhaps, turn out to be of some value. The first is a process for making a neutral acetate of copper. M. Jonas, the author of the process, takes common blue vitriol, dissolves it in caustic ammonia, then adds to the deep blue solution twice the weight (of the sulphate) of acetate of soda, and boils the whole. Silky crystals of acetate of copper immediately appear on the surface and fall to the bottom on agitating the liquid, allowing the formation of a new quantity. The crystals are easily collected and dried on calico or a paper filter: they are said to have a brighter colour than those obtained by the old process, and also to be more soluble in water.

The other process alluded to is the method just patented for obtaining a hardened surface on cast iron. The object or instrument to be hardened is made red hot, and then dipped and allowed to cool in a mixture of 1080 grammes of sulphuric acid, 65 grammes of nitric acid, and 10 litres of water. The thickness of surface hardened is said to be sufficient for ordinary use, and the shape of the object is not at all changed by the operation.

Some talk has been recently excited by the starting of a steam omnibus at Nantes. The papers mention with apparent surprise that there were plenty of passengers who had the courage to ride in it, and only suffered some jolting caused by the badness of the road or the want of springs.

At St. Onen they have lately launched some iron vessels intended to serve as stores for inflammable liquids. They seem to have a special dock for these vessels, and it is supposed that all danger from fire will be obviated by keeping the dangerous fluids on the water. Would not something of the same kind answer for petroleum stores in the Thames and Mersey?

A few days ago three men were suffocated in a sewer at Clichy, and the journals now call attention to a simple form of apparatus which should always be furnished to workmen who are exposed to dangers of the kind. It consists of two india-rubber tubes furnished, we suppose, with valves, through one of which the man inspires, the other carrying off the expired air. The workman has only to fix the open end of these tubes to the top of the ladder, and then descends with a wooden mouth-piece between his teeth. He is thus ensured free communication with the external air, and may remain in the sewer without danger. By the aid of the same apparatus it is said that a man may take his bath entirely submerged, and so derive a great deal more benefit from the operation.

It may interest some of your readers who dread sea sickness, and wish to make a voyage to this country, to be informed that some apparatus designed to save people from the unpleasant malady has been set up in one of the boats plying between Southampton and Havre. I am sorry that I am unable to say which boat, and tell you how the apparatus answers.

M. A. Houdin, of Passy, appears to be teaching the deaf and dumb to speak with great success. A Commission from the Academy lately visited his establishment, and reported that the pupils perfectly understood the questions by observing the motions of their lips, and made oral replies which showed an advanced degree of intelligence. Surely it is worth while for some Englishman to study the methods of M. Houdin.

Italy is truly making progress. They vaccinate in Naples, but not in the common-place way they do here and in London. There is an establishment in which a stock of heifers with the cow-pox is kept, and when a child is to be vaccinated the order is given, a heifer is driven up to your door, the driver nips off an entire pustule, and the doctor then performs his part of the operation. These heifers may be seen going about the streets of Naples, just as I have seen, in years gone by, cows going about the streets of London to be milked at the doors of people who were afraid of a little pump-water. The matter costs a dollar, and at that rate I should think that vacciniferous heifers must pay better than milch cows. It is only fair to King Ferdinand to say that this institution had his support and patronage.

Perhaps you will one day have added to your London cries,—Fresh *lymph* from the cow-ow!

Speaking of Naples, we may add that a scientific congress is about to assemble in that city, to which the Committee invite all *savants*.

I should be sorry to assist quackery or spread a delusion, but I feel bound to inform you that a diet of maize flour is said here to be a certain cure for consumption. It is eaten in the same way as arrowroot, and milk is recommended to be used with it.

Volumetric Determination of Iron.

To the Editor of the Chemical News.

Sir,—Having occasion to make some determinations of iron in solutions of sesquioxide of iron, and finding considerable difficulty in reducing the solution completely with zinc, I tried sulphuretted hydrogen, and found it to answer much better than either zinc or sulphurous acid. A solution of sulphide of sodium was employed by me in the experiments. The reduction, even in a strongly acid solution, takes place immediately; and on boiling until the sulphuretted hydrogen is expelled, the sulphur separated coagulates completely; so that, after allowing the solution to cool in the flask in which it has been boiled, a cork being placed in the neck during the cooling, filtration may be effected so rapidly that no oxidation need be feared, and the determination may then be effected with permanganate as usual. It is better to add a considerable quantity of water to the solution before reduction to avoid the oxidation which would afterwards ensue in the filtration of a concentrated solution of protoxide of iron.

I am, &c. Arthur Reynolds, B.Sc.

The Sulphuring of Hops.

To the Editor of the Chemical News.

Sir,—Will any of your scientific readers suggest to me a ready practical method for detecting whether sulphur has been used in the curing of hops or during their growth? Sulphur is used extensively by the hop-growers, and is very prejudicial to the brewers' fermentations.

I am, &c. A Brewer.

MISCELLANEOUS.

Royal Institution.—The general monthly meeting will be held on Monday, November 7, at 2 o'clock.

Use of Pharmaceutists.—An ill-informed pharmaceutist is more dangerous than an ignorant physician; for the former may cause the death of the patient directly, while the physician has a *lightning conductor* in the way of his homicidal prescriptions; and this lightning conductor is the pharmaceutist.—*Le Moniteur Scientifique*, vol. vi., p. 920.

Benzine as an Insecticide.—A mixture of ten parts benzine, five parts soap, and eighty-five water, has been very successfully used by Gille to destroy the parasites which infests dogs. It has also been used with good results in veterinary practice, as an application in certain diseases of the skin; and thus diluted, is found to answer better than when pure.—*Bull. de Ph. de Brux. N. Jahrb. Ph.* xxi. 36.

ANSWERS TO CORRESPONDENTS.

Chemicus (Blackfriars).—We know of none but careful rectification.

A. Merry.—We will apply to our correspondent for the information, and write if he can furnish it.

A Young Amateur Chemist.—There is a hyposulphite of magnesia, but we do not expect you have it in the mixture described.

W. C. C.—Borax gives with salts of the protoxide of manganese a white precipitate, which is the compound in question.

Z.—A mixture of equal parts of sal ammoniac and slaked lime is put in a capacious retort, which is connected with a series of Wolfe's bottles about half full of water. The first bottle at the end of the operation will contain a solution of about the density.

Chemicus.—The strength may be determined by any alkali. A volumetric method would be most easy. We do not know what is meant by "degrees" as applied to this article.

Received.—Mr. Galletly; Mr. Catton, with thanks.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Relations of Hyposulphite of Soda to Certain Metallic Oxides, by Walcott Gibbs, *M.D., Rumford Professor in Harvard University.*

No. I.

The employment of hyposulphite of soda as an analytical reagent was first suggested by Himly,[*] who, in a short paper, intended only as a preliminary notice, pointed out the relations of this salt to solutions of arsenic, antimony, copper, and platinum, and suggested its use as a general reagent in place of sulphydric acid. Himly's paper attracted little attention, and was soon forgotten. The subject was again taken up at about the same time by Vohl[†] and Slater,[‡] who appear to have been unacquainted with Himly's results. Vohl's investigation embraces the action of the hyposulphite upon solutions of arsenic, antimony, tin, copper, mercury, silver, gold, platinum, lead, bismuth, and cadmium. Slater studied the action of the salt upon solutions of chromium in the form of chromic acid, arsenic, antimony, copper, bismuth, lead, and mercury, as well as upon ferridcyanide, ferrocyanide, and cyanide of potassium, and upon sulphocyanide of iron and hypermanganate of potash. The results obtained by these chemists differ in some particulars, especially as regards copper and lead. More recently Chancel[§] has employed the hyposulphite for the separation of alumina from iron, and Stromeyer[‖] has extended the same process to the separation of iron from titanic acid and zirconia. Other analytical applications of the hyposulphite have been made in which the salt is employed either as a solvent or in volumetric processes; these do not require notice in this place. The following observations on the behaviour of the hyposulphite towards certain metallic salts are interesting from a purely chemical rather than from an analytical point of view.

Nickel.—When a neutral solution of sulphate, chloride, or nitrate of nickel is boiled with a solution of hyposulphite of soda, a black precipitate of sulphide of nickel is thrown down, and after a very long boiling the precipitation is complete, and the solution is free from nickel. If the solution of nickel be previously acidulated by the addition of a drop or two of acetic acid, the precipitation is more rapid. It is very difficult to determine the exact point at which the solution ceases to contain nickel; the boiling must usually be continued for several hours. When chlorhydric acid is added to the mixed solutions of nickel salts and hyposulphite, no precipitate is produced on boiling; in this case nickel behaves like iron and the other metals of the same group; in the cases first mentioned its analogies are with copper. The presence of free ammonia does not prevent the precipitation of sulphide of nickel, but the action goes on very slowly. Rammelsburg[¶] long since observed that a solution of hyposulphite of nickel is partially decomposed by evaporation, and that the dry mass on heating yields a yellow sulphide of nickel; the same is true of a mixed solution containing sulphate of nickel and hyposulphite of soda.

The formation of sulphide of nickel, which takes place slowly in solutions evaporating or boiling under ordinary atmospheric pressure, is facilitated in an extraordinary degree by heating in closed tubes to a temperature of 120° C. Ordinary combustion tubes answer the purpose very well; the tube is first closed at one end, and then drawn out near the other end to a narrow neck. The solution of nickel is introduced by a long funnel, together with the solution of hyposulphite, which should be in excess, and concentrated. After sealing the tube before the blast-lamp, it is to be heated in an air-bath, and kept for half-an-hour at a temperature of about 120° C. Every trace of nickel is thrown down in the form of sulphide mixed with free sulphur; the tube may then be opened at the point, the liquid allowed to flow into a beaker, the tube cut across, and the sulphide of nickel washed out. It may be thrown on a filter and washed with boiling water without oxidising in the smallest degree. The equation representing this reaction appears to be—

$$NiCl + 2NaO,S_2O_2 = NiS + NaCl + NaO,S_3O_5.$$

This process answers extremely well for the analysis of nickel salts, and gives more accurate results than the precipitation of the nickel as oxide by caustic potash; it also requires less time, since the sulphide may be washed with the greatest ease. On the other hand, as I shall show, it is of very limited application as a means of separating nickel from other metals. The sulphide of nickel precipitated by heating with solution of hyposulphite of soda appears black at first, but after ignition has a dark bronze-yellow colour. It is unchangeable in the air, and may be boiled with strong chlorhydric acid without being sensibly attacked. Strong sulphuric acid exerts no action upon it. Nitric acid oxidises it to sulphate of nickel. It may be heated in a covered porcelain crucible without oxidation, but by roasting in a current of air is converted into basic sulphate. For quantitative purposes it is best after washing and drying the sulphide to burn it with the filter in a porcelain crucible, so as to convert it into basic sulphate; to add to this a few drops of sulphuric acid, evaporate to dryness, and gently ignite the resulting neutral sulphate, from the weight of which the nickel may be calculated. The sulphate must be completely soluble in hot water. Rose has shown that the sulphate may be completely converted into oxide by strong ignition.[**]

Cobalt.—The relations of cobalt to hyposulphite of soda are almost identical with those of nickel; the only marked difference consists in the much greater difficulty with which cobalt is precipitated. In fact, a complete precipitation under the ordinary atmospheric pressure is almost impossible. In a sealed tube, at a temperature of 120° C., the precipitation is complete in an hour at farthest. The sulphide is black, and is almost, if not quite insoluble in acids, as the sulphide of nickel; it may be washed upon a filter with boiling water, and does not oxidise in the air. When heated to redness in contact with air, it is readily oxidised to sulphate of cobalt, which is not basic unless the temperature is very high. In all cases, however, it is best to treat the roasted sulphide with a few drops of sulphuric acid, evaporate, and ignite gently. The cobalt may then be calculated from the weight of the sulphate. Cobalt may be easily determined quantitatively in soluble neutral salts by this process; as in the case of nickel, however, the hyposulphite of soda serves to separate cobalt from other metals only in a very limited number of cases. Nickel and cobalt are completely precipitated together as sulphides by hyposulphite of soda at 120° C.; it is best to weigh them together as sulphates, and then determine the cobalt by Stromeyer's method as modified by Dr. Genth †† and myself; the nickel is then found by simply subtracting the weight of sulphate of cobalt from that of the mixed sulphates.

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[*] *Annalen der Chemie und Pharmacie*, xliii., 150.

[†] *Ibid*, xcvi., 237.

[‡] *Chemical Gazette*, 1855, 369.

[§] *Comptes Rendus*, xlvi., 987.

[‖] *Ann. der Chem. und Pharm.*, cxiii., 127.

[¶] *Pogg. Ann.*, lvi., 295.

[**] *Pogg. Ann.*, cx., 112.

Iron.—A solution of peroxide of iron becomes of a deep violet colour upon the addition of hyposulphite of soda; after a short time the colour disappears, and the iron is reduced to protoxide. According to Fordos‡‡ and Gélis the reaction which takes place in this case is represented by the equation—

$$Fe_2Cl_3 + 2NaO.S_2O_2 = NaCl + 2FeCl + NaO,S_4O_5.$$

A solution of a protosalt of iron may be boiled or evaporated with hyposulphite of soda without undergoing any perceptible change. When, however, the two solutions are heated together for an hour or more to a temperature of 130° to 140° C., the hyposulphite of soda being in excess, the whole of the iron is thrown down as a black sulphide, which is not oxidised by exposure to the air, and is not sensibly dissolved by strong chlorhydric acid. Nitric acid readily oxidises it; dilute sulphuric acid has no sensible action. The complete precipitation of iron as sulphide under these circumstances requires a longer time and a higher temperature than that of either cobalt or nickel; the sulphide is the protosulphide FeS, and is readily oxidised to sesquioxide by ignition in a current of air.

When sesquioxide of iron, which has been strongly ignited so as to be with difficulty soluble in acids, is mixed with an excess of dry hyposulphite of soda and heated to redness, a black sulphide is formed, which is readily soluble in chlorhydric acid with evolution of sulphydric acid gas. Nickel and cobalt give insoluble sulphides under the same circumstances; nevertheless, I have not found it possible to separate iron quantitatively from either of the other two metals by this process. From what has already been stated it will also be evident that heating with solutions of the hyposulphite also fails to separate iron from cobalt and nickel.

Alumina.—A dilute solution of alumina, according to Chancel, is completely precipitated by long boiling with hyposulphite of soda, as a hydrate which is easily washed. The reaction is here expressed by the equation—

$$Al_2O_3,3SO_3 + 3NaO,S_2O_2 + 3HO =$$
$$Al_2O_3,3HO + 3NaO,SO_3 + 3SO_2 + 3S.$$

The boiling must be continued until the whole of the sulphurous acid is expelled. Chancel applies this reaction to the quantitative separation of alumina from iron, but I have always found that the complete precipitation of the alumina is, to say the least, extremely difficult. This may be due to the formation of a sulphite which is not decomposed by boiling. When a solution of alum is heated to 120° C., with a strong solution of hyposulphite of soda, the whole of the alumina is precipitated after a short time, as a hydrate mixed with sulphur. The precipitate is white, and of a peculiar semi-gelatinous character; it is more easily washed than ordinary hydrate thrown down by ammonia. It is almost completely insoluble in cold and strong chlorhydric acid, but is slowly dissolved by boiling. Dilute sulphuric acid has no action upon it; strong sulphuric acid and nitro-muriatic acid dissolve it with difficulty.

Zinc.—When solutions of sulphate of zinc and hyposulphite of soda are heated together in a closed tube to 120° to 140° C., the zinc is partially precipitated as a yellowish white powder, which is a mixture of sulphide of zinc and free sulphur. A large quantity of zinc remains in solution.

Manganese.—Sulphate of manganese and hyposulphite of soda may be heated together to 120° C., without any apparent action. When, however, iron is present, the precipitated sulphide of iron always contains manganese, which cannot be separated from it by acids.

The insolubility of the sulphides of cobalt and nickel, when precipitated in the manner above described at high temperatures, led me to examine the behaviour of the sulphides when precipitated under ordinary atmospheric pressure from boiling solutions. When a boiling solution of sulphide of sodium is added to a boiling solution of sulphate of nickel or cobalt, the sulphides are completely precipitated in such a state of aggregation that they may be thrown upon a filter, washed with boiling water, and dried in the air without the least oxidation. It is well before filtering to render the liquid slightly acid, so as to avoid free sulphide of sodium; acetic acid answers best for this purpose. The sulphide of nickel or cobalt, or the mixed sulphides, may be converted into sulphates, and weighed as such.—*American Journal of Science*, vol. xxxvii., p. 346.

Analysis of Parisite; Separation of Cerium, Lanthanum, and Didymium, by MM. DAMOUR *and* H. DEVILLE.

M. BOUSINGAULT has recently received several specimens of *Parisite* from New Grenada, which he confided to the authors for analysis. The following was the process they adopted:—

The mineral reduced to fine powder was treated with cold weak acetic acid, to separate a small quantity of carbonate of lime, accidentally mixed with it, the presence of which is easily accounted for, parisite, like emerald, being found in a vein of carbonate of lime.

Thus purified it was digested, still cold, in nitric acid; carbonates of cerium, lanthanum, and didymium slowly dissolved, with disengagement of carbonic acid; a scaly powder remained, composed of fluorides of calcium and cerium, which was collected on a filter and weighed, after having been heated to redness. These fluorides were decomposed by sulphuric acid. A mixture of sulphates of lime and cerium was thus obtained and dissolved in hydrochloric acid. Ammonia poured into the acid liquid precipitated cerous oxide, which, after calcination, was estimated in the state of ceroso ceric oxide. The lime transformed into oxalate and decomposed by calcination, was weighed in the state of caustic lime. Subtracting the united weights of cerous oxide and lime from the weight of fluorides, we have, by difference, the weight of fluorine.

The nitric liquid separated from the fluorides was supersaturated by caustic potash which precipitated all the oxides in the state of gelatinous hydrates. These oxides were washed several times by decantation, and then a concentrated solution of caustic potash was added, and the whole submitted to a current of chlorine. The alkaline liquid being thus saturated with chlorine, the oxides of lanthanum and didymium were re-dissolved, lemon-coloured insoluble ceric oxide remaining. This substance was collected on a filter, then re-dissolved, while still moist, in hydrochloric acid, and precipitated by oxalate of ammonia, strongly calcined; the cerous oxalate was transformed into very light rose-coloured ceroso-ceric oxide, Ce_3O_4.

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†† *Amer. Journ. of Science* [2], xxiv., p. 86.

‡‡ *Ann. de Chimie et de Physique*, viii., 351.

The chlorinated liquid containing oxides of lanthanum, didymium, and a little lime, was treated by oxalate of ammonia, which precipitated the three bases as oxalates. They were weighed after being washed and calcined, then digested with very weak nitric acid by M. Mosender's method. A little oxide of cerium remained undissolved, and was added to that already obtained in the preceding operation.

The nitric acid solution of oxides of lanthanum and didymium, coloured violet red, was saturated with ammonia; the lime remained in the liquid while the other oxides were precipitated in a gelatinous state. The lime was estimated as caustic lime, after precipitation by oxalate of ammonia, and calcination of the oxalate; a little lanthanum and didymium were found mixed with it and were taken into account in the final result.

The oxides of didymium and lanthanum were re-dissolved in nitric acid, and the nitrates evaporated to dryness in a flat-bottomed capsule. The dried mass was of a pale rose tint. By exposing the capsule for a few minutes to a temperature of 400° or 500° the saline mass was fused with disengagement of nitrous vapours. The capsule was withdrawn from the fire before the decomposition was complete, and hot water was poured in. Part of the matter dissolved and part remained insoluble in the form of greyish-white flakes (with no nitrate of didymium). The whole was left to stand for a few hours, then boiled and filtered; and as the liquid still retained a feeble rose tint, the same operation was repeated three times before a colourless liquid was obtained, containing nitrate of lanthanum, separated from subnitrate of didymium. Oxide of lanthanum was determined by evaporating this liquid and strongly calcining the residue. The oxide of didymium was also estimated after the calcination of the subnitrate thus obtained.

This process is founded on the fact that nitrate of didymium decomposes before nitrate of lanthanum, and that the first of these salts changes to the state of subnitrate, $4DiONO_5 + 5HO$ (this salt has already been observed and described by M. Marignac). Several precautions must be observed. The bottom of the capsule containing the mixture of the two salts must not be too much heated, nor must too large quantities of material be used, as in that case it forms a thick layer at the bottom of the capsule and decomposes unequally. It is better to recommence the operation several times than to heat too strongly in attempting to separate the two oxides at the same time. The first portions of oxide of didymium obtained in this way give, with sulphuric acid, reddish-violet crystals, with traces of white needle-form ones, which seem to belong to the sulphate of lanthanum. The last portions give a sulphate less coloured, but like the preceding with the same crystalline form derived from the oblique rhomboidal prisms; the needles of sulphate of lanthanum are rather more numerous; in short, the above-described colourless solution gives, with sulphuric acid, colourless crystals derived from the right rhomboidal prism characteristic of sulphate of lanthanum.

By following this method we obtain rather too high an estimation of oxide of didymium, and consequently one rather too low of oxide of lanthanum. By operating on a mixture of these oxides previously weighed, we found that the excess of oxide of didymium varied from 5 to 6 per cent.

We cannot, then, give this mean analysis as yielding precise results, but it may prove a sufficiently near approximation.

Oxide of lanthanum calcined at white heat, and put in contact with a concentrated solution of ammoniacal nitrate readily dissolves, even without heat, disengaging ammoniacal gas; oxide of didymium similarly treated also dissolves, but somewhat more slowly; consequently this property cannot be utilised for the separation of the two oxides. To estimate the carbonic acid combined with oxides contained in parisite, a gramme of this mineral, reduced to a very fine powder, was heated to whiteness in a current of nitrogen; the decrease in its weight gave the quantity of carbonic acid disengaged; the number obtained very nearly corresponds to that already determined by M. Bunsen. The fluorides contained in the parisite are not decomposed by this calcination.

Having endeavoured to collect the proportion of water existing, according to M. Bunsen's analysis in parisite, we placed a gramme of this substance, reduced to an impalpable powder in a platinum boat, which we placed in a crucible of the same metal six centimetres long, with a screwed cover furnished with a small tube, traversing a stopper of hard asbestos in a glass tube, bent to a semicircle and tapered at the extremity opposite to that where the small platinum tube is placed. The glass tube intended to collect the water disengaged during the calcination of the mineral having been exactly weighed, we heated by an enameller's lamp the part of the platinum crucible containing the boat and the substance to be analysed. Slight vapours were disengaged and condensed inside the glass tube, but on weighing this tube it was found to have increased in weight scarcely one milligramme.

In another experiment we did not pulverise, but broke up the mineral into fragments, which when treated in the same manner decrepitated and projected into the condensing tube a brown powder of great tenuity without apparently disengaging more moisture than in the preceding experiment. According to these results parisite would hold no water in combination. The presence of the 2·50 per cent. of water found by M. Bunsen may be explained by admitting the accidental interposition of the liquid in some of the interstices of the mineral. On breaking parisite crystals we find, in fact, in their interior small hollows lined with microscopic crystals. It is possible that in these cavities infinitesimal quantities of water were interposed, which would disappear when the mineral was reduced to impalpable powder.

The apparatus described as having served in the research for water in parisite had been previously employed successfully in determining the water in minerals containing but a very small proportion of it, such as euclase, idocrase, diallages, talcs, &c. It has the advantage of rendering visible the water disengaged from minerals by heat, and of allowing it to be transferred so as to undergo various tests.

The mean of these analyses has given the following numbers:—

			Oxygen.	Relation.
Carbonic acid . .	0·2348		0·1708	6
Cerous oxide . .	0·4252		0·0699	2
Oxide of didymium .	0·0958	0·0137	0·0339	1
Oxide of lanthanum .	0·0826	0·0121		
Lime	0·0285	0·0081		
Manganous oxide .	traces			
Fluoride of calcium .	0·1010			
Fluoride of cerium .	0·0216			
	0·9895			

Parasite, then, may be represented by the formula,—

$$2CeOCO_2 + (\tfrac{1}{2}DiO.\tfrac{1}{2}LaO)CO_2 + (Ca,Ce)Fl.$$

—*Comptes Rendus*, lix., 271, 64.

TECHNICAL CHEMISTRY.

Carburation of Iron by Contact or Cementation, by M. FRED. MARGUERITTE.

THE theory of the carburation of iron has been the subject of many controversies. Not wishing to discuss all the opinions relating to this subject, I have simply sought to ascertain whether carbon combines with iron directly by contact or by cementation.

Guyton-Morveau (*Annales de Chimie et de Physique*, series 1, xxviii., 19) was the first who attempted to prove that alteration takes place by simple contact. He calcined a diamond in an iron crucible placed in a Hessian crucible. After undergoing about an hour of intense heat the iron crucible was completely changed into a mass of melted steel.

Thus, says Guyton-Morveau, the diamond disappeared by the attractive force of the iron favoured by the high temperature to which they were both exposed, just as one metal disappears in forming an alloy with another metal.

Nevertheless, the transformation of iron into steel exclusively by the contact of the diamond may be contested, as the iron crucible during the whole time of calcination was exposed to the carburising action of the gases of the furnace. The question seems as yet unresolved; and M. Chevreul recently said before the Academy (*Comptes Rendus*, 1861, lii, 424):—

"It is important to know, 1. Whether it is true, as Guyton says, that iron may be converted into steel with diamond powder; 2. Whether, if such be the case, the transformation is effected without the intervention of nitrogen."

The object of this paper is to show that iron carburises, is converted into cast iron when heated in contact with carbon, and is also transformed into steel without the intervention of nitrogen. The essential conditions of the experiment are carried out as follows:—I operated—

1. With pure carbon (diamond);
2. In an atmosphere of chemically pure hydrogen;
3. In vessels absolutely impermeable to the gases of the furnace;

So that the possible combination of the diamond and iron was complicated by no foreign action.

The experiment was thus effected:—Hydrogen was prepared with distilled zinc, and pure sulphuric acid, purified and dried with the greatest care, in the way indicated by MM. Dumas and Sainte Claire Deville; that is to say, that the gas traversed successively apparatuses filled with acetate of lead, sulphate of silver, pumice stone saturated with potash, and cold sulphuric acid, after having passed through spongy platinum heated to dull redness.

Thus purified and dried the hydrogen was carried through a doubly glazed porcelain tube, whose perfect impermeability had been tested, which was heated to the melting point of cast iron. In the tube was a small porcelain boat, on the edges of which rested a very fine plate, which had been previously and for a long time heated in a current of hydrogen, so as to free it from its sulphur and nitrogen.

On the iron plate was placed a diamond which had been slightly heated; a cold hydrogen current was passed through the apparatus for several hours, to free it from air,—that is to say, from oxygen and nitrogen. The temperature was then rapidly raised to red heat, and kept at this point for some time. The tube was then taken from the furnace and cooled, remaining in the hydrogen current.

It was found that the diamond on the iron plate had made a hole, as if with a puncher, whence it had fallen into the boat beside a small globule of cast iron.

In the second operation five small diamonds traversed a soft iron plate, and in disappearing gave well melted globules of cast iron.

In the third experiment a larger diamond and a thicker iron plate were used. The diamond pierced and became inserted in the plate.

Then a fourth experiment was made for the purpose of producing steel.

The hydrogen current was directed on an iron wire 1½ milimetre in diameter, half of which was covered with coarse diamond powder contained in a platinum boat.* The part of the wire plunged in the diamond dust was cemented, while the rest of it remained unaltered.

After having used diamond, we operated on plumbago and sugar charcoal calcined for a long time in a hydrogen current.

After heating strongly the tube containing the charcoal, an iron wire was introduced into it 1½ millimetre in diameter. In three minutes the end of the wire in the carbon dust was transformed into cast iron, the globules of which were found. The temperature was lowered, and in the same space of time the extremity of another wire was converted into very hard fine-grained steel, while the part not in immediate contact with the charcoal showed no sign of any change. This confirms M. Berthelot's observation that if hydrogen were capable of forming acetylene or any other carbonised compound, the whole of the wire would have been cemented.—*Comptes Rendus*, lix., 139.

PHARMACY, TOXICOLOGY, &c.

On a Means of Detecting Nitro-benzol in Oil of Bitter Almonds, by M. DRAGENDORFF.

THIS test consists in acting on the adulterated oil with sodium in the presence of alcohol. This metal, in contact with pure oil of bitter almonds, disengages gas, which is augmented by the addition of alcohol, and white flocks are formed. Nitro-benzol under the same circumstances with alcohol becomes deep brown or black and viscid.

In testing the adulterated oil, take ten or fifteen drops of it, add four or five drops of alcohol, and a fragment of sodium; a brown deposit, approaching black, in proportion as the nitro-benzol is in excess, occurs. This reaction is instantaneous, and when the oil contains from 30 to 50 per cent. of nitro-benzol one minute is sufficient to obtain a thick brown liquid.—*Journ. de Pharm.*

On a New Falsification of Saffron, by M. GUIBOURT.

M. VESQUE, Pharmacien of Lisieux, has received recently from a house in Paris, under the name of "*Safran du Gatinais*," 250 grammes of a saffron of inferior quality, containing about 30 per cent. of a material judged to be the stamens. Professor Decaisne, who has examined this substance, has recognised in the length of the filaments the cylindrical form of the anthers and the large size of the pollen grains, that these stamens are those of a *Crocus*. But they are not the stamens of the mother plant, which have been inadvertently collected with the stigmata, the colour of which is yellow and easily distinguishable. They are evidently collected intentionally, dyed artificially, and twisted so as to deceive the eye, and in quantity equal to nearly a half of the article. The adulteration is recognised by throwing a certain quantity into a glass of water. The stamens are instantly decolorised and float, whilst the true stigmata fall to the bottom of the water. On comparison with the figures of Hayne, these stamens belong to the *Crocus vernus*, by the cylindrical form of their anthers, rounded at the summit, whilst the anthers of *Crocus sativus* are terminated like an arrow. Finally, this saffron contains also little marigold petals, coloured red like the stamens; these sink in water with the stigmas of the saffron, and are recognised by their base, their longitudinal nervures, and three-pointed terminations. I do not know what opinion to give of a merchant who thus falsifies saffron; the man who takes your purse from your pocket is not more culpable.—*Journ. de Pharm.*, Juin., 1864.

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* Several good diamonds were pounded in a steel mortar, the powder boiled in nitric acid to free it from any metallic particles, and then slightly heated.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 3.

Professor A. W. Williamson, Ph.D., F.R.S., *President, in the Chair.*

At this the opening meeting of the Society during the present session there was an unusually large attendance of members, and a sufficient amount of business to occupy the Society until a very late period in the evening.

The minutes of the last ordinary meeting (in June) having been read and confirmed, and a very long list of library contributions acknowledged, Mr. Wm. Baker, of Sheffield, and Mr. G. W. Knox were formally admitted as Fellows of the Society. The names of several candidates for the same honour were then read over for the first time; amongst them were Colonel H. Y. D. Scott, Royal Engineers, South Kensington Museum; Lieutenant Hosier, 2nd Life Guards; Dr. Hermann Sprengel; Mr. John Berger Spence, Manchester; Mr. J. G. F. Richardson and Mr. Daniel Harvey Jay, Leicester; Mr. Henry Haywood, Broom Hall Park, Sheffield; Mr. Charles Eken, Bath; and Mr. William White Rouch, Norfolk Street, Strand.

The President then read a resolution of the Council to the effect that the names of several members of the Society who had allowed their subscriptions to lapse for the three last years be removed from the list of Fellows. After the third reading of this resolution it was proposed to ascertain the feeling of the Society with regard to it by ballot.

A paper was read by Professor Wanklyn "*On Valeryl, the Radical of Valerianic Acid.*" The author began by referring to some very old researches of Löwig and Wiedmann, wherein it was shown that when acetic ether is acted upon by potassium or sodium it does not evolve ethyl, but gives ethylate of sodium and other products. According to the prevalent opinion, acetic ether should yield ethyl just as iodide of ethyl yields ethyl when it is acted upon by a metal. Mr. Wanklyn had repeated Löwig and Weidmann's experiment with acetic ether, and confirmed their result in so far as the non-evolution of ethyl was concerned. With valerianic ether and sodium or potassium he got likewise no evolution of ethyl. From a review of the chief reactions of acetic ether, Mr. Wanklyn came to the conclusion that it was more correctly described as ethylate of acetyl than as acetate of ethyl. Of course, the same would apply to other ethers, and thus valerianic ether should be ethylate of valeryl. Experiments made with sodium and valerianic ether gave this result. One molecule of valerianic ether is decomposed by one atom of sodium yielding one molecule of ethylate of sodium and one equivalent of valeryl. Or doubling—

$$2\left.\begin{matrix}C_5H_9O\\C_2H_5\end{matrix}\right\}O+\left.\begin{matrix}Na\\Na\end{matrix}\right\}=2\left.\begin{matrix}Na\\C_2H_5\end{matrix}\right\}O+\left.\begin{matrix}C_5H_9O\\C_5H_9O\end{matrix}\right\}$$

In the experiments described, a weighed quantity of valerianic ether was sealed up with a weighed quantity of sodium and some dry common ether. After action in the water bath the tube was opened, no gas escaped. The residual unacted upon sodium was then cleaned and weighed; the difference between this weight and the weight of the sodium taken gave the sodium actually consumed. The amount of ethylate of sodium formed was determined by titrating the caustic soda produced by reaction with water. It was found that the quantity of valerianic ether taken, the quantity of sodium consumed, and the quantity of ethylate of sodium formed were what the above equation requires. The oil formed had the composition of valeryl. In conclusion the author promised to make a minute examination of valeryl, and of several of the acid-forming radicals, and remarked that the result of the research was the disclosure of a new general law in organic chemistry.

An explanation of the formation of carbonic ether from oxalic ether was also given.

The President remarked upon the unexpected nature of the reaction discovered by Professor Wanklyn; he should rather have anticipated the elimination of hydrogen; the formation of the acid radical in this simple manner was a fact of great interest and importance.

Dr. Frankland made a similar remark, and inquired of the author whether he had yet tried the action of chlorine upon the radical? The speaker was now engaged conjointly with Mr. Duppa in a somewhat similar line of research; the experiments were not, however, sufficiently advanced to enable him to make a statement on the present occasion.

Professor Wanklyn, in reply to Dr. Odling, said that he had not yet succeeded in making the valeryl-sodium; and that time had not permitted of his examining fully the action of chlorine; so far it appeared to be split up into a hydrocarbon and a valerate.

The President next called upon Mr. William Baker, of Sheffield, to give an account of some experiments made by himself and Mr. Graham Stuart "*On the Existence of Nitrogen in Steel.*"

This research was directed to the repetition of M. Fremy's investigations, using, however, the characteristic varieties of Sheffield steel, Bessemer steel, "J. B." iron, and other British brands, besides the well-known Spiegeleisen now largely used in the manufacture of steel. A full account of these results must unavoidably be deferred until next week, but it may be stated at once that the important conclusion to which the authors have arrived is to the effect that there is no clear evidence of the existence of nitrogen in steel, nor in any of the brands of iron which they have examined. The authors referred incidentally to the possible existence of the nitride of titanium in steel and titaniferous iron, which might under such special circumstances account for the appearance and detection of nitrogen amongst other normal constituents.

Mr. William Baker, Associate of the Royal School of Mines, then read the following paper, entitled "*On the Occurrence of Nickel in Lead, and its Concentration by Pattinson's Process.*"

It is well known that for certain manufactures lead of a high degree of purity is required. The presence of a very small amount of copper especially is injurious for making white lead and glass makers' red lead. Investigating the cause of a peculiar tint in glass which was sometimes sufficiently marked to be called blue, and was readily accounted for by the presence of copper, I sought carefully for cobalt, but only found nickel. In all the samples of English lead which I have examined I have never detected a trace of cobalt. On the contrary, traces of nickel have frequently been found in various samples of Derbyshire lead, in Yorkshire lead, and lead from Snailbeach, Shropshire. Operating upon 2000 grains I have found the following quantities of nickel in the pig lead as delivered by the smelter:

	Per cent.		oz.	dwts.	grs.	
Derbyshire lead, 1st sample	0·0023	=	0	14	8	per ton.
,, ,, 2nd ,,	0·0031	=	0	19	14	,,
,, ,, 3rd ,,	0·0023	=	0	14	8	,,
Snailbeach lead . . .	0·0007	=	0	5	10	,,
Softened slag lead . .	0·0057	=	1	16	14	,,

On submitting lead containing these quantities of nickel to Pattinson's process, I find a concentration of the nickel in the fluid portion. Crystals of lead were taken out in the proportion of 9-10ths, leaving 1-10th fluid lead of a five ton charge.

Samples of the fluid lead, or "bottoms," upon analysis, contained nickel as follows:—

	Per cent.		ozs.	dwts.	grs.	
After 3 crystallisations .	0·0047	=	1	10	1	per ton.
,, 1 ,, .	0·0043	=	1	7	10	,,
,, 1 ,, .	0·0062	=	2	0	12	,,
,, 2 ,, .	0·0072	=	2	7	0	,,

In all cases a weighable quantity could be obtained from 2000 grains of lead.

Per cent. ozs. dwts. grs.

Five tons of lead contained ·0068 = 2 4 10 per ton. Four and a-half tons were removed as crystals, and when

Per cent. ozs. dwts. grs.

melted contained only ·0047 = 1 10 1 per ton. These figures show that nickel remains to a great extent with the fluid portion, much as copper does, and I have reason to suppose that when it reaches a certain amount, as in the case with copper, the separation is no longer effected, or only in a very small degree. In the case of copper, this is easily understood when it is seen that, at a low temperature, copper (in the absence of antimony and arsenic) will separate and be found in the dross on skimming, leaving the fluid lead containing about 20 ozs. per ton = 0·06 per cent. To effect a separation of the copper by Pattinson's process the amount at the commencement should not be more than 10 ozs. per ton.

A sample of lead from five tons, when analysed, gave no indications of the presence of nickel; on crystallising 9-10ths, the remainder gave distinct traces of the metal. In refined lead I have only once succeeded in obtaining a weighable quantity, and only rarely found traces in nickel. That it is not removed by oxidation is proved by the larger quantity found in the fluid portion of the lead when crystallised, as well as by the fact that in the softened slag lead which is submitted to the powerful oxidising action of nitrate of soda a considerable quantity of nickel is still found.

Professor A. H. CHURCH then read a paper "*On the Blue Colour of Forest Marble.*" This rock, which is a well known member of the oolitic series, is externally of a fawn colour, but always contains a darker-coloured, bluish grey interior portion, to which the author's remarks particularly referred. The common explanation was to the affect that the iron, existing to the amount of about one per cent., was in the form of protoxide in the interior and peroxidised without; but a more critical examination showed that the blue colour was due to the occurrence of bisulphide of iron, which had become converted in the external portions into a soluble sulphate of iron, which, reacting upon the carbonate of lime in the presence of air, formed sulphate of lime and hydrated peroxide of iron. The analytical examination proved that sulphur existed wholly as sulphate of lime in the external crust, whilst, by digesting the blue interior mineral in dilute hydrochloric acid, an insoluble residue remained, which was composed, to the extent of 16 per cent., of bisulphide of iron, and there was some sulphate of lime in solution. By mixing together iron pyrites and carbonate of lime, both in the state of very fine powder, the author succeeded in imitating the bluish tint of the natural rock.

Professor Church then proceeded to give an account of some experiments he had lately been making upon "*The Effect of Ignition on Garnets, &c.*" In the *Proceedings* of the Royal Society, vol. xiii., p. 241, would be found recorded some extraordinary statements tending to show that certain minerals of the idocrase and garnet family underwent expansion when exposed to a red heat, but only went back again to their normal dimensions after the lapse of a month or other considerable period of time. That, in fact, the specific gravity of lime garnet, originally 3·35, was reduced to 2·98 by being heated to redness for a quarter of an hour, and allowed to cool; and that the mineral being left at rest for a month regained its original density. Professor Church then proceeded to challenge the accuracy of these observations, and described the results of his own experiments upon the same minerals, by which it was proved that in no single instance was there any indication of the "intermittent molecular change" which the author lays claim to having discovered. Amongst the numerous results brought forward by Mr. Church were the following:—

	Original Density.	Density after being Heated to Redness and Cooled.
Idocrase	3·384	3·385
Do. (another specimen)	3·400	3·401
Brown-red iron garnet .	4·058	4·045
Iron garnet	4·130	4·050
Lime garnet . . .	3·666	3·682
Olivine	3·389	3·378

The specific gravities of beryl, chrysoberyl, and topaz were likewise identical before and after ignition. Many of these minerals became *permanently* reduced in density by the action of a temperature sufficiently high to cause fusion. Thus, the specimen of idocrase originally 3·40 was diminished to 2·937 by fusion, and the brown-red iron garnet from Arundel became reduced to 3·395, and even to 3·204 by longer fusion. It is well known that heat is sometimes employed as a means of altering the colour and imparting increased brilliancy to natural gems. A large Indian zircon in the possession of the speaker, which weighs between 2 and 3 grammes, has a specific gravity = 4·696—a number not widely different from 4·534, which M. Damour obtained by heating to redness a natural zircon of original gravity 4·183. Mr. Church concluded by stating his conviction that the remarkable assertions communicated to the Royal Society in May last were not founded upon correct observation, and before publishing this as his final conclusion he had made upwards of seventy experiments, so that it is obvious there must be some occult cause for results so anomalous. It must be admitted, however, that he (Mr. Church) failed to comply with some of the conditions set forth by the author, viz., "The diminution of density being noted, the specimens were carefully dried, enveloped in several folds of filtering paper, and put aside in a box *along with other minerals.*"

Mr. PERKIN having suggested that the anomalous gravities might be accounted for by the specimens having been weighed whilst yet warm, the meeting was adjourned by the President until the 17th instant.

The name of the author was not mentioned by Professor Church. On turning to page 240 of the *Proceedings* of the Royal Society, vol. xiii., we find a "*Note on the Variations of Density produced by Heat in Mineral Substances,*" by Dr. T. L. Phipson, F.C.S., &c. Communicated by Professor Tyndall.

LECTURES ON CHEMICAL PHILOSOPHY.—VI.

Delivered at the College of France, by M. A. Wurtz.

The Theory of Types.

The idea of types flows naturally from the theory of substitutions. We discover the germ of it in the derived radicals which are brought into relation with a fundamental radical. It is in this way that the radicals

$$C_2H_3Cl$$
$$C_2H_2Cl_2$$
$$C_2H_2O$$

are related to the fundamental radical

$$C_2H_4,$$

from which they are derived by substitution. All these nuclei belong to what has been since named the *mechanical type.*

But strictly speaking the theory of types only begins with the study of the chlorinated derivatives of acetic acid by Dumas.

Dumas discovered that in the acid $C_2H_4O_2$ we can substitute Cl_3 for H_3, and so form the acid $C_2HCl_3O_2$. Having compared the properties of these two bodies, he found that both were powerful monobasic acids, and that both, under the influence of alkalies, split up in the same way.

$$\underbrace{C_2H_4O_2}_{\text{Acetic acid.}} = CO_2 + \underbrace{CH_4}_{\text{Marsh gas.}}$$

$$\underbrace{C_2HCl_3O_2}_{\text{Terchloracetic acid.}} = CO_2 + \underbrace{CHCl_3}_{\text{Chloroform.}}$$

In a word, Dumas recognised that acetic acid and terchloracetic acid, which are derived one from the other by the substitution of Cl_3 for H_3, and which contain the same number of atoms, grouped in the same manner, possess also the same fundamental properties. He expressed these facts by saying that these two acids belonged to the same chemical type. He endeavoured also to demonstrate that the chemical properties of a compound depend less upon the nature of the constituent elements than upon the way in which these elements are grouped. Chlorine, he said, although endowed with properties quite opposite to those of hydrogen, may be substituted for the latter in a compound without modifying its fundamental properties, because the grouping may remain the same.

This was a novel and bold idea, and perhaps rather exaggerated in form, for certain facts of substitution which have been discovered since have demonstrated that the properties of bodies depend at once upon the nature of the atoms and the manner in which they are grouped.

Regnault came afterwards bringing the idea of mechanical types, and placing in the same group all bodies which contain an equal number of atoms, whether their fundamental properties are the same or not.

The idea of types enunciated for the first time by Dumas was true and fruitful: it bore a germ capable of immense developments; but in its first form it was susceptible of no great extension.

It regards each primitive compound as a particular type to which all the bodies derived by substitution are related. The number of types was too great, so the theory needed at the same time extension and simplification. And thus we soon see it assume a new form, and by becoming allied with the fundamental principle of atomicity, its value is doubled.

Laurent was the first who compared hydrate of potassium with water. He showed that hydrate of potassium results simply from the substitution of one atom of potassium for one atom of hydrogen in a molecule of water.

$$HHO + K = KHO + H$$

If we take this hydrate, and treat it with potassium, we have

$$KHO + K = KKO + H$$

KKO or K_2O is anhydrous potash: it only differs from water by the substitution of K_2 for H_2.

If we treat this oxide K_2O by water H_2O, we shall have

$$\left.\begin{matrix}H\\H\end{matrix}\right\}O + \left.\begin{matrix}K\\K\end{matrix}\right\}O = \left.\begin{matrix}K\\H\end{matrix}\right\}O + \left.\begin{matrix}K\\H\end{matrix}\right\}O$$

Thus in these reactions hydrate of potassium and oxide of potassium are derived from water directly by substitution.

Generalising upon these facts, Laurent compared the anhydrous oxides and the hydrates to water. The potassic, sodic, and argentine oxides, and the potassic, &c., hydrates also belong to the type of water, and their formulæ are similar.

$$\left.\begin{matrix}K\\K\end{matrix}\right\}O \quad \left.\begin{matrix}Na\\Na\end{matrix}\right\}O \quad \left.\begin{matrix}Ag\\Ag\end{matrix}\right\}O \quad \left.\begin{matrix}K\\H\end{matrix}\right\}O \quad \left.\begin{matrix}Na\\H\end{matrix}\right\}O.$$

The idea of an *ammonia type* arose out of my own studies and those of Hofmann on the compound ammonias. In the communication in which I announced the discovery of compound ammonias, I remarked that these bodies might be regarded as ammonias in which one equivalent of hydrogen is replaced by methylium or ethylium. I represented these relations in the following way:—

$$\underbrace{NH_2H}_{\text{Hydramide.}} \quad \underbrace{NH_2CH_3}_{\text{Methylamide.}} \quad \underbrace{NH_2C_2H_5}_{\text{Ethylamide.}}.$$

A few months later Hofmann discovered diethylamine and triethylamine, which he represented thus:—

$$\underbrace{\left.\begin{matrix}H\\H\\H\end{matrix}\right\}N}_{\text{Ammonia.}} \quad \underbrace{\left.\begin{matrix}C_2H_5\\H\\H\end{matrix}\right\}N}_{\text{Ethylamine.}} \quad \underbrace{\left.\begin{matrix}C_2H_5\\C_2H_5\\H\end{matrix}\right\}N}_{\text{Diethylamine.}} \quad \underbrace{\left.\begin{matrix}C_2H_5\\C_2H_5\\C_2H_5\end{matrix}\right\}N.}_{\text{Triethylamine.}}$$

He thus formulated the typical idea more clearly than I had done it myself.

The ammonia type was adopted by chemists without difficulty, but still only from an isolated point of view; the doctrine was not yet constituted in its entirety. Towards this end the labours of Williamson gave the most decisive movement. These labours relate to etherification and the constitution of ethers.

When sulphuric acid, H_2SO_4, reacts on alcohol, C_2H_6O, sulphovinic acid is formed by a double substitution.

$$\left.\begin{matrix}H\\H\end{matrix}\right\}SO_4 + \left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O = \left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}SO_4 + \left.\begin{matrix}H\\H\end{matrix}\right\}O.$$

Williamson has shown that ether is formed by the action of sulphovinic acid on alcohol in the following manner:—

$$\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}SO_4 + \left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O = \left.\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right\}O + \left.\begin{matrix}H\\H\end{matrix}\right\}SO_4,$$

which shows us that ether contains two ethylic molecules. This fact has been definitely proved by the discovery of mixed ethers.

Williamson by the action of sulphovinic acid on amylic alcohol—

$$\left.\begin{matrix}C_5H_{11}\\H\end{matrix}\right\}O$$

reproduced the sulphuric acid, and formed an ethylamylic ether—

$$\left.\begin{matrix}C_2H_5\\C_5H_{11}\end{matrix}\right\}O.$$

He has also obtained an ethylmethylic ether—

$$\left.\begin{matrix}C_2H_5\\CH_3\end{matrix}\right\}O$$

by the reaction of iodide of methyl on ethylate of sodium

$$\underbrace{\left.\begin{matrix}C_2H_5\\Na\end{matrix}\right\}O}_{\text{Ethylate of sodium.}} + \underbrace{CH_3I}_{\text{Iodide of methyl.}} = NaI + \underbrace{\left.\begin{matrix}C_2H_5\\CH_3\end{matrix}\right\}O}_{\text{Methylethylic ether.}}$$

The eminent chemist saw at once the import of his discovery. Water being

$$\left.\begin{matrix}H\\H\end{matrix}\right\}O$$

alcohol must be

$$\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O$$

and ether

$$\left.\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right\}O;$$

which is the same as saying that alcohol only differs from water by having (CH_3) substituted for H, and ether only differs from water by having $(C_2H_5)_2$ substituted for H_2. And this is not a purely theoretical view; we can really effect these substitutions, and follow them, so to speak, step by step.

When we throw potassium into water, one atom of hydrogen will be displaced, and potassic water or hydrate of potassium, will be formed.

$$\left.\begin{matrix}H\\H\end{matrix}\right\}O+K=\left.\begin{matrix}K\\H\end{matrix}\right\}O+H^{*}$$

If, now, we heat together an alcoholic solution of hydrate of potassium and iodide of ethyl, hydrate of ethyl and alcohol are formed—

$$\left.\begin{matrix}K\\H\end{matrix}\right\}O+C_2H_5I=\left.C_2\begin{matrix}H_5\\H\end{matrix}\right\}O+KI.$$

Thus, just in the same way as in ordinary water

$$\left.\begin{matrix}H\\H\end{matrix}\right\}O$$

we can replace H by K, so in the ethylated water or alcohol we can likewise turn out the atom of hydrogen by potassium—

$$\underbrace{\left.\begin{matrix}CH_3\\H\end{matrix}\right\}}_{\text{Hydrate of ethyl.}}O+K=\underbrace{\left.C_2\begin{matrix}H_5\\K\end{matrix}\right\}}_{\text{Ethylate of potassium.}}O+H.$$

We can now replace K in

$$\left.\begin{matrix}C_2H_5\\K\end{matrix}\right\}O$$

by the group C_2H_5, and so arrive at ether. To effect this it is only necessary to heat ethylate of potassium with iodide of ethyl—C_2H_5I.

The metamorphosis is accomplished thus:—

$$\left.\begin{matrix}C_2H_5\\K\end{matrix}\right\}O+\left.C_2\begin{matrix}H_5\\I\end{matrix}\right\}=\left.\begin{matrix}K\\I\end{matrix}\right\}+\left.\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right\}O.$$

We thus see that ether really contains two ethylic molecules, since we can add one after the other, and so prove the series of the phenomena indicated above.

(To be continued.)

PHARMACEUTICAL MEETING.

Wednesday, November 2.

Mr. Hills, *Vice-President, in the Chair.*

On commencing the business of the evening, the Chairman called attention to a "*Poison Bottle,*" which was exhibited to the meeting. The novelty consisted in a metal cap which covered the stopper, and was retained in its position by two spring clasps, which grasped the neck of the bottle. By pressure on two pins the clasps were withdrawn, and the cap could be removed.

Professor Bentley shortly noticed some specimens of materials used for scenting teas in China, presented to the Society by Messrs. Piesse and Lubin. These are mixed with tea, and the two are allowed to remain in contact for a longer or shorter time, after which the perfumed material is sifted out.

Professor Bentley then read a short paper by Dr. W. F. Daniell, "*On the Production of Hydrocyanic Acid from Bitter Cassava Root.*" The writer said that prussic acid was first found in the juice of cassava root by two French chemists in 1836, and the fact had subsequently been confirmed by Christison. The investigations for the present paper had been made by Mr. Hughes, a young creole chemist, who had pursued his studies under great difficulties. The circumstance that hydrocyanic acid was found in plants growing in tropical climates, the author considered as deserving attention, since it was known that the ordinary acid would not keep in hot climates. It soon changed into a carbonaceous liquor, which had neither taste nor odour. Recently, a quantity of imported acid had been condemned as worthless at the Military Depôt in Kingston, Jamaica. There are two sorts of cassava root, known as the bitter and the sweet. No botanical differences are recognisable, but the negroes know how to distinguish between them. It seems to be doubtful (as we gathered from the paper) whether or not the root is poisonous when first dug up. Hogs and poultry, it was said, then feed on it with impunity, eating the red earth in which the plant grows as an antidote. But when the cortical portion of the root is stripped off, and it is exposed to air, a kind of fermentation sets up, and the juice is converted into a virulent poison. (A sample of the juice, which had a scarcely perceptible odour of prussic acid, was handed round, together with another bottle containing a distillate from the juice. The latter had a much more pronounced odour of hydrocyanic acid.) In time it would appear the acid is dissipated by evaporation, and the starch is then washed out of the roots. The bitter cassava is cultivated in Jamaica for the starch which is sold in Kingston market to adulterate arrowroot. In Western Africa Dr. Daniell wrote, the negroes put the root on the fire to drive off the poison, and make an alcoholic drink by fermenting the starch. Professor Bentley added that the interest of the paper consisted in the proof it gave that a deadly poison like prussic acid was yielded by a root which also yielded two such valuable substances as arrowroot and tapioca. Two plants were cultivated to furnish these, the bitter and the sweet cassava—one poisonous, the other quite innocuous. The roots of these showed no botanical differences, but certain physical differences of much interest were easily remarked.

Mr. Morson said the odour of hydrocyanic acid was very distinct in the distillate from the juice. The acid was probably formed by a kind of fermentation.

Dr. Edwards remarked on the fact that the red earth was considered an antidote for the poison. It probably contained oxide of iron, which was an antidote for prussic acid.

Dr. Redwood said that the paper did not add much to our knowledge of the subject. The facts related were trifling, and the paper did not inform us how the prussic acid was obtained from the juice, nor the quantity it yielded. We were still in the dark as to what the poisonous effects of cassava root were due. They might perhaps be due to something else than prussic acid, which acid was probably found under peculiar circumstances. The acid, it had been shown, could be found from a variety of vegetable substances, apple pips among others.

Professor Bentley said the paper did not pretend to indicate the poisonous principle of cassava. It was only confirmatory of a previous assertion.

Mr. A. F. Haselden then read a paper "*On the Extracts of the British Pharmacopœia which are Prepared from Dry Material.*" The author commenced by remarking that up to the present there had been no discussions on the British Pharmacopœia at the meetings of the Society, and he thought the time had arrived when the experience of pharmaceutists with the new processes might be brought before the meeting, and useful conclusions be drawn as to the value of the formulæ. The paper now brought forward would, he hoped, be one of a series in which he intended to lay before the Society the results of his own experience with one important class of medicines. The first extract he would notice was extract of Calumba. This extract is new to the British pharmaceutist, and is taken from the Prussian Pharmacopœia. It is directed to be prepared by

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[*] In order to avoid a useless complication, the author has not doubled this and the analogous equations.

macerating one pound of Calumba root in powder with two pints of proof spirit for twenty-four hours; after which the material is to be percolated with two more pints of spirit; the tincture is then to be distilled to recover the alcohol, and the residue evaporated to a proper consistence. This process, the author said, was extremely wasteful. No directions were given either for displacing the whole of the spirit or for pressing the marc, and consequently, if the directions of the Pharmacopœia were closely followed, one-half the extract obtainable was lost, and one-fifth of the spirit remained absorbed by the marc. Moreover, the extract when finished was a tough leathery mass, by no means convenient for use, and which now costs two shillings an ounce. The yield of extract by the Pharmacopœia process was only one and a-half ounce from a pound of the root. Mr. Haselden thought that there could be no objection to displacing the whole of the spirit by means of water; the product could not be injured by the admixture of a little water with the tincture. But was spirit necessary for the production of a good extract of Calumba? The bitter principle of the root was readily soluble in cold water, and by percolating the root with cold water two ounces and a-half of good extract might be obtained from a pound of Calumba. By using boiling water the yield was further increased to three and a-quarter ounces, but an objection was made to an extract so made on the score of its containing starch. Mr. Haselden considered the presence of starch rather advantageous than otherwise, since it gave consistence to the extract, and might also be useful in a therapeutical point of view, in support of which latter opinion he read an extract from Pereira's "Materia Medica."

The discussion was opened by Mr. Mackay, who led it completely away from the subject of the paper by asking if any one present knew how the extracts shown by M. Berjot in the Exhibition of 1862 were made?

Professor Redwood said that the extracts alluded to were extremely beautiful to look at, but not at all adapted for ordinary pharmaceutical use. While kept perfectly dry they resembled tannic acid somewhat in appearance; but were so hygroscopic, that on the slightest exposure to moisture they shrank into a dirty mass. This defect of readily absorbing moisture, the Professor remarked, was common to all extracts prepared from vegetable juices when the chlorophyll was separated. The clear juice of conium gave an extract which, in a few weeks, became as thin as treacle. The cause of this was probably the deliquescent nature of the salts contained in this and similar juices. When the chlorophyll was returned to the extract it might perhaps protect these salts from the moisture of the atmosphere, in the same way that starch prevents chloride of calcium from deliquescing.

Mr. Hanbury agreed with Dr. Redwood that the French extracts were not worthy of imitation. Though beautiful in appearance they were so prone to absorb moisture that it was practically impossible to keep them.

Mr. Haselden then made another communication "*On the Extract of Liquorice*" of the British Pharmacopœia. After comparing the process of the British with past Pharmacopœias, the author said the present process was expensive and defective on some points. The amount of water to be added to the coarsely powdered root was not sufficient for maceration; the mixture, when made, was apt to ferment in a warm place, and moreover, it packed very badly in a percolator. With the addition of more water in the preliminary maceration the process would answer very well and yield a very good extract, but at a cost of 4s. 6d. per lb. The author did not object to the cost of a medicine when commensurate advantages were obtained, but in the present instance he considered that a process of his own yielded an equally good extract at a smaller cost. He took the larger fresh roots of liquorice, bruised them with a mallet, cut them into convenient lengths, and then placed them in a copper with three pints of water to every pound of root. Heat was now applied, and the decoction was just allowed to simmer. After standing all night, the decoction was run off in the morning and strained through a canvas bag, after which it was evaporated to one-third of its bulk. The process was repeated with the root, and this decoction was evaporated like the first; the rich liquor was added to the poor towards the end of the evaporation, and thus a long application of heat to the former was avoided. In this way he obtain from the fresh root 22 per cent. of a good sweet rich extract, which was quite soluble in water, and left no deposit on standing. The cost of this extract was 3s. per lb. A larger amount of extract was procured when the decoction was strained whilst hot. The fresh root then gave 35 per cent. of extract (at a cost of 2s. per lb.) which contained mucilage and other matters, but was useful for making lozenges. This extract was not quite soluble in cold water, and becomes dark on keeping.

Specimens of extracts made by all the processes named were handed round.

Mr. Hills said the papers read were of a very useful practical character, and deserved the thanks of the meeting. He considered the extract made by the Pharmacopœia process the best.

Mr. Morson, on the contrary, thought that made when the decoction was strained hot was the best.

Mr. Umney said that the Pharmacopœia process would not answer on the large scale. The method pursued by wholesale manufacturers was as follows:—The coarsely-powdered root was placed in a large barrel, and wetted with water. After standing twenty-four hours the liquor was drained off, and the marc pressed. The extract was then finished according to the Pharmacopœia. If the root was left in contact with the water more than twenty-four hours, fermentation was very likely to be set up. The amount of extract obtained by this process was greater than that procured by Mr. Haselden in following the Pharmacopœia directions.

Mr. Groves thought the extract made from the dried roots was inferior to that made from the fresh; it had an acrid taste, which was objectionable.

The meeting then adjourned until Wednesday, December 7th, when a paper "*On the Gamboge Tree of Siam*" will be read by Mr. Daniel Hanbury, F.S.S.

ACADEMY OF SCIENCES.

October 31.

M. Becquerel contributed a memoir "*On the Preservation of Iron and Cast Iron in Soft Water.*" Our readers will remember that a month or two ago the author announced that iron-plated vessels could be preserved from oxidation by fixing bands of zinc over the iron plates at intervals. It seems that in soft water the protection is not so complete, and a larger surface of zinc is required to ensure perfect preservation. The present memoir is devoted to a statement of the electric condition of the plates, which shows that in salt water the current set up at the point of contact of the two metals extends a long distance, and that the intensity diminishes very slowly. In soft water, however, the intensity diminishes rapidly; nevertheless, the protection may be made complete, as we have said, by the use of a larger surface of zinc. The author found that 9387 cannon balls of 12 centimetres diameter under soft water required for their protection bands of zinc having a surface of two square metres. M. Becquerel makes another suggestion for the protection of water pipes of cast iron in wet earth. If these should prove sufficient conductors they might be protected for great distances, and it would only be necessary to have openings at intervals to allow of the zinc being got at for the surface to be cleaned.

M. Isidore Pierre contributed the first part of a second memoir "*On the Development of Corn.*" The present part relates to the increase in the weight of the different parts of the ear, which takes place in the period between the termination of the flowering and the time of gathering the corn. This period in the author's experiment this year lasted nineteen days. During this time the whole ear increased 80 per cent. in weight. At the same time the stalk and husks of the ear are undergoing a progressive diminution of weight, while the grain constantly goes on increasing. Passing over the stalks and husks, we may note the circumstance that the dry matter in a kilogramme of grains increased from 329·5 grammes to 616·2 grammes during these nineteen days. Another curious fact is, that while on July 6 the mineral substances in the grain amounted to 25·579 grammes per kilogramme, the amount on July 25 had diminished to 19·54 grammes per kilo. The nitrogen in the same time had increased from 18·29 grammes to 22·81 grammes. The author seems to think that the grain is nourished at the expense of the upper part of the stem of the plant.

M. Maguerittte continues his apparently interminable dispute with M. Caron as to the agent which produces *the cementation of iron.* He sticks to the point which the reader will see in another paper we publish to-day—namely, that it is either carbon alone or carbonic oxide which produces steel, and that practically cyanogen alone will not effect the change.

M. Hautefeuille communicated another note "*On the Titanates and Some Silicates.*" The author described the way in which he formed monobasic titanates of lime and magnesia, and bibasic titanates of lime, iron, and manganese, and also corresponding silicates. The natural tendency of both silica and titanic acid, it seems, is to form monobasic compounds with lime and magnesia, and bibasic with magnesia, iron, and manganese.

NOTICES OF BOOKS.

Elements of Materia Medica: containing the Chemistry and Natural History of Drugs; their Effects, Doses, and Adulterations, &c., &c. By Dr. W. Frazer. London: Churchill and Sons. 1864. Second Edition.

The study of the materia medica and therapeutics is by no means popular in the Medical Profession. Lectureships on the subject generally fall into the hands of junior physicians, who must lecture upon something. Students get up the chemistry and botany of the Pharmacopœia for the examinations, and having passed them, straightway forget both, remembering for the most part only such simple facts concerning remedies as that opium is a sedative, senna and calomel are purgatives, and ipecacuanha an emetic, expectorant, diaphoretic, &c. As they get on in life, most men acquire some peculiar views relative to the action of medicines, and thus their treatment of disease becomes day by day more and more empirical.

By a natural reaction against the exclusive reliance on medicines which up to recent times characterised the practice of the healing art, there is a now wide-spread scepticism as to the value of remedies altogether. The effect of this, we fear, is to be seen in our works on Materia Medica. They are becoming more and more simple manuals by which to get up the subject for the examinations. Some are cut down to "the Essentials." The three goodly-sized volumes of Pereira, in which that great teacher only professed to give the "Elements" of the subject, are, we understand, undergoing a similar process of evaporation and concentration to one small volume. Perhaps this is to some extent unavoidable. A medical student has so many subjects "to get up" in these days, that it is impossible for him to give much attention to more than one or two, and therapeutics is not one of these. Still it might be thought that a knowledge of the action of remedies was of sufficient importance to make it a prominent subject in the course of preparation for Medical practice. Such, however, does not seem to be the opinion of those who ought to know more about these matters than we do.

With regard to Dr. Frazer's book. It is just such a book as is in demand now. The author is an experienced teacher, and has been an examiner on the subject, and knows well what medical students are expected to know. The botany and chemistry are not so much dwelt upon as by some writers on the subjects, but the account of the effects of remedies is fuller, which is a decided recommendation to the book. We may also say a word in praise of the external getting up of the book. It is issued with cut edges, as we should be glad to see all books issued.

Skin Diseases; their Description, Pathology, Diagnosis, and Treatment. With a copious Formulary. By Tilbury Fox, M.D. Lond., &c., &c. London: Hardwicke. 1864.

We do not know what the medical profession will have to say to this work, but it seems to us to have one great want. It is quite destitute of illustrations, and a book on skin diseases without coloured plates appears to us as absurd as a book on flowers without the same kind of illustrations. For a student such a book must necessarily be useless. Apart from this want, however, the book is very good. The verbal descriptions of the appearances of skin diseases are as good as they could be, and the etiology and treatment of the various affections are fully treated of.

We notice some omissions. For instance, we see no allusion to the treatment of lepra by diuretics, from which we have seen the best effects derived; but in general the practitioner well acquainted with the appearances of skin diseases will find in the volume all the recent improvements in their treatment.

The formulary added to the work will, no doubt, prove useful to medical men in prescribing, but not in preparing medicines. Under the head Mist. ferri iodidi we find the following:—"N. B.—The liq. ferri iodidi is made by macerating in three pints of water ʒiv. of iron filings, ʒiiss. of iodine, and ʒiij. of glycerine." The practitioner who tries to make a liq. ferri iodidi in the way indicated, we may as well say will probably fail in the attempt.

A Dictionary of Chemistry and the Allied Branches of the Sciences. By Henry Watts, B.A., F.C.S. London: Longman and Co. Part XXI.

This number gives the completion of a very able article "*On Light,*" by Dr. Roscoe, and carries the work on as far as Lipic Acid.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2105. Charles George Lundborg, Sodertelje, Sweden, "An improved mode of extracting oils from coal or other bituminous substances yielding hydrocarbon oils."—Petition recorded August 26, 1864.

2318. Theodore Anthony Roehussen, Friday Street, Cheapside, London, "Improvements in the construction of furnaces for melting metals in crucibles, and also in the construction of crucibles."—Petition recorded September 21, 1864.

2486. Charles Hastings Collette, Lincoln's Inn Fields, Middlesex, "Improvements in magneto-electric machines." A communication from Theodore Fancheux, Avenue Trudaine, Paris, France.—Petition recorded October 10, 1864.

2553. Thomas Randle, High Street, Hoxton Old Town, Middlesex, "A new preparation or compound substance for the eradication of corns, bunions, worts, and excrescences of the like nature on the feet or hands."—Petition recorded October 15, 1864.

2641. Edward Henry Taylor, Padeswood, near Mold, in the county of Flint, "Improved apparatus for drawing off or emptying the contents of casks, ships' tanks, and other vessels containing petroleum, paraffin, and other matters or liquids, and also the application of similar apparatus for the supply and stoppage of air."—Petition recorded October 25, 1864.

2645. James Dannatt, borough of Sunderland, in the county of Durham, "An improved composition for preventing the fouling of the bottoms of ships and vessels, and for the preservation of the iron or wood of which the same are constructed."

2653. John Nimmo, Borrowstowness, in the county of Linlithgow, N.B., "Improvements in apparatus for distilling oils or resinous matters."—Petitions recorded October 26, 1864.

Notices to Proceed.

1501. John Macarthy, Alderney Road, Mile End, Middlesex, "Improvements in apparatus or means employed for freezing or cooling fluids or other matters." A communication from Edward Preble Torrey, New York, U.S.A.—Petition recorded June 16, 1864.

1529. Joseph Hamilton Beattie, Dowgate Hill, London, "Improvements in the means of preventing the formation of, and in the removal of, incrustations or deposits from steam-engine boilers." A communication from Joseph Marks, Montreal, Canada.—Petition recorded June 20, 1864.

1533. Wilhelm August Abegg, Westminster Palace Hotel, Victoria Street, Westminster, Middlesex, "Improvements in apparatus for distilling spirituous liquors."—A communication from Carl Falkman, Saint Petersburg, Russia.

1543. Thomas Ogden Dixon, Steeton in Craven, *via* Leeds, Yorkshire, "Improvements in stoppers for bottles, jars, and similar articles, and in means or apparatus for withdrawing such stoppers from bottles, jars, and similar articles."—Petitions recorded June 21, 1864.

1570. Alexander Hett, London, and Frederick William Basset, Camberwell, Surrey, "Improvements in preserving animal and other substances."—Petition recorded June 23, 1864.

1599. Benjamin Franklin Stevens, Trafalgar Square, Middlesex, "Improvements in the application of petroleum, coal oil, and other similar substances to the purposes of heating, lighting, and obtaining motive power, and in the apparatus employed therein."—A communication from Simon Stevens, New York, U.S.A.—Petition recorded June 25, 1864.

1655. William Edward Gedge, of the firm of John Gedge and Son, Wellington Street, Strand, Middlesex, "Improvements in the firework known as Roman candle."—A communication from Henri Frédéric Favre-Convel, Nantes, France.—Petition recorded July 2, 1864.

2137. John Stenhouse, Rodney Street, Pentonville, Middlesex, "Improvements in rendering certain substances less pervious to air and liquids, and also less liable to decay."—Petition recorded August 31, 1864.

2237. Zoheth Sherman, Durfee, Pittsburg, Pennsylvania, U.S.A., but at present residing at Birmingham, Warwickshire, "Improvements in apparatus for generating gas for fuel, and in furnaces for applying gaseous fuel to metallurgical and other operations."—Petition recorded September 13, 1864.

2413. John Johnson, Runcorn, Cheshire, "Improvements in decomposing common salt with sulphuric acid in the manufacture of soda and muriatic acid."—Petition recorded September 30, 1864.

2472. George Haseltine, Southampton Buildings, Chancery Lane, Middlesex, "An improved process for purifying coal and ores."—A communication from Benjamin Franklin, Penniman City, County, and State of New York, U.S.A.—Petition recorded October 7, 1864.

CORRESPONDENCE.

Continental Science.

Paris, November 8.

The great scientific event of last week was the *soirée* given by General Morin at the Conservatoire des Arts et Metiers, for the benefit of the Associations for the Advancement of Astronomy and Meteorology. It was a most brilliant affair, and the display of machines and instruments of all kinds was magnificent. The exterior and large apartments of the building were illuminated by the electric light. In the large amphitheatre a number of experiments on optics applied to acoustics, and others with the Rhumkorff coil were shown, which Dr. Tyndall and Mr. Ladd have made familiar to the frequenters of the Royal Institution and most scientific gatherings in London. A small concert was given in the little amphitheatre, where an artist performed some music on Marie Antonette's harpsichord. More than 2000 visitors were present, who departed at a late hour, immensely gratified by what they had seen.

Englishmen have often to laugh at the mistakes which French journals fall into when dealing with English affairs. They are sometimes not much happier when dealing with matters further from home. Just now the scientific journals of Paris are having a laugh at their daily political contemporaries for gravely announcing a week or two ago, among the astronomical events of November, that "the planet Mars, *which is only visible every fifteen years*, will be at its brightest this month, and may be readily distinguished in the evening by its red light." By way of excusing his countrymen, M. Flammarion suggests that the writer of this paragraph was thinking of Saturn's ring, which becomes *invisible* every fifteen years!

As a fact likely to be interesting to some of your readers, I may mention that M. Alcan has recently published a complete treatise on the manufacture of cotton. It is a book which I should think would have great interest for cotton manufacturers. The machinery is very fully described and explained, and this part of the work is illustrated with a large number of beautifully executed engravings. In the first part the author gives a complete account of all kinds of cotton, and, indeed, all textile substances, and whatever has yet been proposed as a substitute for cotton. He also gives a full account of the development of textile industry. The last part contains useful hints on the construction of a factory, and its arrangements, &c., which, although given from a French point of view, may, nevertheless, have some value in the North of England.

A Monsieur Damoiseau has recently called attention to a monstrous (artificial) leech—Térabdelle—which he has invented. It seems to have many advantages over the old-fashioned pneumatic cupping apparatus. The author is able to draw, with one glass, 60 grammes of blood per minute, and the blood does not immediately form a clot which plugs the vessels, as with the cupping-glass. Blood-letting is so much out of fashion in England that probably no one will take any notice of this invention, and yet it seems to offer advantages which are deserving of attention.

The French carry out the principles of association to a much greater extent than you do in England. M. About, in *Le Progrès*, has recently tried to persuade the young men of Paris to combine for the purpose of getting good and cheap dinners, and his advice is likely to be taken. In the meantime, I may inform you that there is in Paris, under the name of the National Union of Commerce and Industry, a society composed of a large number of manufacturers who, by a small annual subscription, support an analytical laboratory, which is under the direction of M. Poinsot, from whom they can have advice and assistance in their respective trades. The same society is about to start a journal which is to be partly of a social character, but is also to contain scientific articles of value. And that is all the news that I can gather this week.

On the Equivalent of Indium.

To the Editor of the Chemical News.

Sir,—From the equivalent of indium given in your last impression (viz., 463·4, $O = 100$; or 74·14, $O = 16$), it seems probable that that metal is the mean of a triad consisting of silicon, indium, and tin; or, perhaps, of another triad composed of aluminium, indium, and uranium.

If we regard indium as belonging to the same group as zinc, it will form one of a series of elements having consecutive equivalents, including Cr, Mn, Fe, Co, Ni, Cu, Zn, and In; the equivalent of zinc being the mean of those of iron and indium.

We must, however, wait for further details of the properties of this newly-discovered element, and especially of its atomicity, before it can be safely assigned to any particular group.

It will be seen that the equivalent of indium is next in numerical order to that of zinc, and but slightly below that of arsenic; and we have already observed that "elements having consecutive equivalents frequently either belong to the same group or occupy similar positions in different groups." I am, &c.

John A. R. Newland, F.C.S.

Laboratory, 19, Great St. Helens, E.C., Nov. 8.

Alteration in the Weight of Copper.

To the Editor of the Chemical News.

Sir,—It is a curious fact that if a certain weight of rough copper be made into forgings the weight of the forgings produced from the copper will be greater than the original weight of the rough copper, which, it would appear, thus increases by hammering. To a stranger this may appear ridiculous, but any practical person who has had anything to do with copper forging can verify the fact. Can you kindly give any explanation of this paradox?

I am, &c. W. A. B.

October 28.

MISCELLANEOUS.

The Royal Society.—The election of the following officers and council will take place on St. Andrew's day, November 30, 1864. The Fellows whose names are printed in italics were not members of the last Council:—

President—Major-General Edward Sabine, R.A., D.C.L., LL.D.

Treasurer—William Allen Miller, M.D., LL.D.

Secretaries—William Sharpey, M.D., LL.D.; George Gabriel Stokes, Esq., M.A., D.C.L.

Foreign Secretary—Prof. William Hallows Miller, M.A.

Other Members of the Council—*Prof. John Couch Adams, M.A.;* James Alderson, M.D.; George Busk, Esq., Sec. L.S.; Col. Sir George Everest, C.B.; Hugh Falconer, M.A., M.D.; *John Peter Gassiot, Esq.; John Edward Gray, Ph.D.; Thomas Archer Hirst, Ph.D.; Sir Henry Holland, Bart., M.D., D.C.L.;* Henry Bence Jones, M.A., M.D.; *Sir Roderick Impey Murchison, K.C.B.; William Odling, M.B.;* Prof. William Pole, C.E.; *Rev. Bartholomew Price, M.A.; Sir John Rennie, Knt.; the Lord Stanley.*

Baron Liebig.—The *Moniteur Belge* contains the following extract from the *Journal de Francfort*:—"A friend writes from Munich that the celebrated chemist, Baron Liebig, is about to resign his professorship and laboratories at the University of Munich, with the intention of settling in London to occupy an important position which has been offered to him *par la grande compagnie du balayage et des vidanges de Londres*," whoever they may be.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following papers will be read:—Dr. Marcet, "Brine of Salted Meat;" Professor Wanklyn, "Nature of Compound Ethers."

Dye for Feathers.—An important branch of the art of dyeing feathers for the toilet has lately undergone much improvement, through the discovery of aniline colours. Before being dyed, feathers ought always to be well cleaned and blanched, to get rid of the fatty or colouring matters. After properly assorting the feathers, treat them with a tepid solution of 0 kil. ·062 of soap in 1 kil. of water. Let the feathers steep in this bath until the soap has had its effect; then repeat the operation in another soap bath. Then wash the feathers in plenty of water, bleach them with sulphurous acid obtained by the combustion of sulphur, and wash and dry them. Feathers are dyed black by boiling in an alum and logwood bath, with the addition of sulphate of copper and iron; lilac by archil; carmine, indigo and alum; yellow of various shades, by acetate of lead and chromate of potash, or better still, by arnotto and a solution of potash; green, by a solution of indigo and picric acid; blue, by a solution of indigo and alum, or better by nitrate of iron and yellow prussiate of potash; red, by cochineal or Brazil wood. But the most beautiful shades of red, violet, and blue are obtained with aniline colours, which adhere to feathers with as much brilliancy as to silk or wool. It is only necessary to plunge the cleaned feathers into the bath of aniline colours, and to let them remain until completely dyed. As now made, pure and dry aniline colours, such as red, violet, and blue, merely require to be dissolved in alcohol and then diluted with water, before being poured into the bath. Besides aniline and the colours derived from it, French purple gives very various shades. The dye bath must not be kept too hot, as the feathers would be attacked. After dyeing, the feathers are washed, dried, and curled, the latter operation being performed with a well-polished bone knife.—*Moniteur Scientifique*, vi. 664, 64.

Cotton Seed Oil.—Lipowitz states that the deep brown commercial oil parts with its colouring matter readily by treatment with alkaline solution, yielding from 80 to 85 per cent. of a clear yellow oil, which is almost entirely without smell, and resembles in taste the finest salad and poppy-seed oils. It solidifies at from 3° to 0° C. The crude oil, which may be ranked among the drying oils, has a sp. gr. of ·928 at 15° C., the purified oil of ·9206. The fatty portion of the crude oil amounting to 15 or 20 per cent., which is readily saponified by alkalies, may be obtained by the action of acids upon the soap in the form of a brownish or greenish butter-like mass, which is well adapted for a waggon or machine grease, since it remains fluid a long time in a warm place, and does not resinify. It may also be used for the preparation of an odourless potash or soda soap.—*N. Jahrb. Ph.* xx. 330.

ANSWERS TO CORRESPONDENTS.

Alpha.—The last edition of Fowns's and Watts' Dictionary.

A. C.—Apply to Messrs. Trübner and Co., Paternoster Row.

J. C., Bath.—The best special work on the subject is in French, by Louis Grandeau.

D. T. O.—1. One and a-half parts of iodine are dissolved in one part of aniline: hydrochloric acid is added to the mixture. The crystals obtained are washed with dilute hydrochloric acid, and purified by several crystallisations. 2. Probably a sulphite.

Pamphlet Received.—De l'Alimentation des Enfants. Mémoire de Mme. Baines.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Synthesis of Butyric and Caproic Acids,[*] by ALFRED R. CATTON, *B.A., Fellow of St. John's College, Cambridge, and Fellow of the Cambridge Philosophical Society.*

(Continued from page 207.)

To return now to the deposit produced in the original evaporation in air of the calcium salts.

The whole of these deposits were collected and boiled with a mixture of thirty-five parts of water and one of concentrated nitric acid. After boiling for a quarter of an hour, about one-half of the deposit dissolved; the residue was of a dark brown colour, similar to the brown deposit before mentioned, produced on evaporating the mixture of the potassium salts. This dark brown residue was collected on a filter, washed, and dried. The filtrate, still considerably acid, was evaporated in vacuo, over sulphuric acid.

The residue was treated with a small quantity of absolute alcohol to dissolve out the nitrate of calcium. The remainder, which was perfectly white, was dried at 100° C. ·0526 grm. of the salt gave ·0276 grm. of sulphate of calcium. The salt, therefore, contained 15·3992 per cent. calcium; caproate of calcium contains 14·8148 per cent. calcium.

The foregoing analyses prove conclusively that an acid having the same molecular weight as caproic acid—viz., 116—is produced in the reaction.

This acid having the molecular weight 116, possessed also the general characters of caproic acid. It had a strong sudorific odour.

The calcium salt was soluble in about forty-nine parts of water, and its solution deposited a basic salt $C_{12}H_{11}CaO_4.Ca_2O_2$ when heated.

The silver salt was precipitated on the addition of nitrate of silver to the calcium salt. It was completely soluble in boiling water.

It remains to show that this acid possesses the same percentage composition as caproic acid, and that its more minute characters agree with those of caproic acid.

To return now to the brown residue insoluble in dilute nitric acid.

On being dried, this residue became white; but on the addition of water a portion of it again became brown, the other part remaining white, and the same thing occurred on again drying and then adding water. The solution was colourless, and on being evaporated again gradually became yellow, and formed a flocculent deposit.

The white portion dissolved completely on the addition of 150 parts of water; while, from a rough determination which I made, the brown portion did not dissolve till 8370 parts of water had been added.

Neither caprylate nor caprate of calcium requires more than 200 parts of cold water for its solution; whilst laurate of calcium requires about 10,000 parts, the calcium salts of all higher acids being as little soluble as laurate of calcium.

From these facts it appears probable that the white portion was a mixture of caprylate and caprate of calcium; and that the brown portion was either laurate of calcium $C_{24}H_{23}CaO_4$, or a mixture with laurate of calcium of the calcium salts of higher acids,—myristic, stearic, &c.

Unfortunately, there was not enough either of the white or brown portion for a calcium determination, so the two were added together, and an analysis made of the calcium in the mixture. ·0421 grm. gave ·0164 grm. of sulphate of calcium, or ·0048 Ca. The salt, therefore, contained 11·4014 per cent. Ca. Caprylate of calcium contains 12·2699 per cent. Ca. Caprate of calcium contains 10·4712 per cent. Ca. The quantity of calcium was therefore intermediate between caprylate and caprate of calcium, thus pointing to the presence of caprylic acid, and also of higher acids, capric, lauric acid, &c.

The production of such high acids in the process as capric and lauric acids is rendered additionally probable by the following facts:—When the mixture of the potassium salts of the acids obtained by precipitation with subacetate of lead and decomposition by sulphuretted hydrogen, was evaporated, a brown deposit, before alluded to, was formed. It was insoluble in a large quantity of cold water.

Now, as the neutral potassium salts of all the fatty acids are easily soluble in water, it only appears possible to account for this brown deposit on the supposition that it was an acid potassium salt of one of the higher fatty acids, for it is well known that there is a great tendency to deposit acid potassium salts on evaporating solutions of the neutral potassium salts of those acids nearly insoluble in water. This view is corroborated by the fact that this same brown deposit was formed on adding a few drops of acetic acid to the mixture of the potassium salts after the solution had been considerably concentrated by evaporation.

I now proceed to consider the explanation of these experiments. When I commenced them I was under the impression that it was a fact generally known and admitted by chemists that sodium-alcohol decomposed at a certain temperature not much above 100° C. into ethylene and hydrate of sodium. In order, therefore, to show that sodium-alcohol was at the temperature employed during the reaction decomposed in this manner, I was content with observing the following facts:—

1. That an inflammable gas, not containing vapour of alcohol, and burning with a bright white flame, was evolved during the reaction.

2. That the contents of the retort were of a dark coffee-brown colour, and had the same appearance as when alcohol is heated for a length of time with caustic soda (or potash).

I relied upon the first fact as proving the evolution of ethylene, and on the second as showing the presence of caustic soda in the retort. When I read this paper before the British Association, however, this fact was denied by one chemist.

Being now at a distance from works of reference, I cannot state exactly where I read that sodium-alcohol does decompose in this manner. But Hofmann certainly observed the fact in his researches on the action of cyanate and cyanurate of ethyl on sodium-alcohol.

By the action of cyanate of ethyl on sodium alcohol Hofmann obtained triethylamine, and he observes that, in many cases, sodium-alcohol affords a convenient means of ethylation, but that its use is limited on account of the low temperature at which it decomposes.

In the action of cyanurate of ethyl on sodium alcohol some of the same products were obtained as in the action of caustic soda on this compound—viz., hydrate of carbotriethyltriamine and ethylamine, and ethylene was evolved in abundance. The theory of this reaction Hofmann distinctly states to be the decomposition of the sodium-alcohol by heat into ethylene and caustic soda.

I am aware that Wanklyn's experiments show that it is not decomposed at 100° C.; but I conceive that the evolution of an inflammable gas burning like ethylene and the production of caustic soda in the retort are quite sufficient to show that the decomposition did take place at the temperature of the experiment, 236°—238° F., 113·3°—114·4° C.

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[*] The experiments described in this paper were communicated to the Chemical Section of the British Association, September 16, 1864.

I shall take care to prove conclusively that such is the case in my future experiments.

I observed, however, that the decomposition of the sodium-alcohol took place very slowly at this temperature, which was the principal reason why the reaction had to be continued for seventy hours, and even at the end of this time the greater portion remained undecomposed.

I intend, on repeating these experiments, to operate in sealed tubes, which, by increasing the pressure and therefore the temperature of the boiling point, will greatly facilitate the decomposition of the sodium-alcohol.

Two theories may be advanced to account for the production of butyric and caproic acids in these experiments. It may be supposed that the acetate of sodium takes no part in the reaction; in fact, that its only use in the process is to raise the boiling point to the temperature of decomposition of the sodium-alcohol. On this view the sodium-alcohol decomposes into ethylene and caustic soda; and the ethylene when in the nascent state combines with the alcohol with the production of butylic alcohol. Thus—$C_4H_6O_2 + C_4H_4 = C_8H_{10}O_2$.

And further, a portion of the butylic alcohol thus produced is converted into a hexylic alcohol by combination with nascent ethylene. Thus—

$$C_8H_{10}O_2 + C_4H_4 = \overset{\text{a Hexylic alcohol.}}{C_{12}H_{14}O_2}.$$

We must suppose that the butylic and hexylic alcohols are converted with evolution of hydrogen into butyrate and caproate of sodium, by the action of the caustic soda produced in the process:—

$$C_8H_{10}O_2 + H_2O_2 = \overset{\text{Butyric acid.}}{C_8H_8O_4} + 2H_2$$

$$C_{12}H_{14}O_2 + H_2O_2 = \overset{\text{Caproic acid.}}{C_{12}H_{12}O_4} + 2H_2$$

The other theory which may be advanced is that the butyrate of sodium is produced by the combination of acetate of sodium with nascent ethylene. Thus—

$$\overset{\text{Acetate of sodium.}}{C_4H_3NaO_4} + C_4H_4 = \overset{\text{Butyrate of sodium.}}{C_8H_7NaO_4},$$

and that the caproate of sodium is produced by the combination of nascent ethylene with a portion of the butyrate of sodium. Thus—

$$C_8H_7NaO_4 + C_4H_4 = \overset{\text{Caproate of sodium.}}{C_{12}H_{11}NaO_4}.$$

This was the view I took of the reaction in my paper before the British Association.

I believe, however, that the nascent ethylene combines both with the alcohol producing butylic and hexylic alcohols, and with the acetate of sodium producing butyrate and caproate of sodium; but I doubt whether the alcohols are converted into butyrate and caproate by the action of the caustic soda. It is for this reason that I believe the butyrate and caproate of sodium are produced principally, if not entirely, by the combination of nascent ethylene with acetate of sodium.

It is to be observed, however, that in order to account for the production of butyrate and caproate of sodium, one of these processes must go on, and even if the combination with acetate of sodium does not take place at all, that with alcohol must; and it is quite as important to have converted ordinary alcohol into butylic and hexylic alcohols as to have converted acetate of sodium into butyrate and caproate of sodium.

Future experiments will decide whether one only (and if so which) or both of the processes referred to go on together.

The method of synthesis given in this paper was suggested by a theory of the molecular constitution of carbon compounds which differs from the views at present adopted by our most eminent chemists. It will probably prove to be a general process applicable to all series of carbon compounds, so that any given term of a homologous series will be converted into any higher term by direct union with nascent ethylene or one of its homologues—*e.g.*, ordinary alcohol into heptylic alcohol by combination with one molecule of nascent amylene produced by the decomposition of amylate of sodium; oxalate of potassium into succinate of potassium by combination with one molecule of nascent ethylene; benzoate of potassium into cuminate of potassium by combination with one molecule of nascent tritylene, &c.

It has been already shown by M. Lippmann that dichloroformic aldehyd (phosgene) is converted into dichloropropionic aldehyd (chloride of lactyl) by direct combination with one molecule of ethylene.

This method of synthesis is capable of great extension by substituting for ethylene and its homologues other hydrocarbons and oxidised compounds when in the nascent state, thus enabling us to obtain from one compound others belonging to different homologous series. These hydrocarbons and oxidised compounds will be produced by different methods in different cases; in many cases, probably, by the decomposition of the compounds obtained by the action of sodium or potassium on the other alcohols, aldehyds, acetones, glycols, &c. For instance, there appears to be no reason why sodium-aldehyd $C_4H_3NaO_2$ should not decompose when heated in a sealed tube into acetylene C_4H_2 and hydrate of sodium.

$$C_4H_3NaO_2 = C_4H_2 + NaHO_2.$$

Berthelot has found that by heating aldehyd in a sealed tube for 100 hours a number of polymeric hydrocarbons are produced having the formula $n(C_4H_2)$; in this case we may suppose that acetylene was first produced and afterwards converted into the hydro-carbons $n(C_4H_2)$ by molecular condensation.

The method of synthesis thus generalised has already been applied, although the theory of the process has not been understood by chemists. We will give two examples:—

Städeler has shown that when sodium is dissolved in anhydrous acetone two higher compounds, pinacone and phorone, are produced. In the first place, sodium-acetone is produced, but it is decomposed by the heat generated by the violent action of sodium on acetone in the manner represented by the equation,

$$C_6H_5NaO_2 = C_6H_4 + NaHO_2.$$

The hydrate of sodium is separated in white flakes. The hydrocarbon C_6H_4 (which is, no doubt, identical with allylene), combines at the instant of formation with acetone with production of the compound $C_{12}H_{10}O_2$. The compound thus produced combines again with C_6H_4, produced by the decomposition of another portion of sodium-acetone with the formation of phorone—

$$C_{12}H_{10}O_2 + C_6H_4 = \overset{\text{Phorone.}}{C_{18}H_{14}O_2}.$$

In the experiment, however, the hydrogen produced by the action of the sodium on acetone is not given off, but when in the nascent state combines with the compound $C_{12}H_{10}O_2$, converting it into anhydrous pinacone—$C_{12}H_{12}O_2$.

In a late number of Erlenmeyer's *Zeitschrift*, M. Borodin has shown that by the action of sodium on valeral two compounds $C_{20}H_{20}O_2$ and $C_{20}H_{22}O_2$ are produced, and also valerate of sodium. The theory of this reaction, however, appears to be different from that of the action of sodium on acetone.

Valerate of sodium appears to be first produced as follows:—

$$\overset{\text{Sodium-valeral.}}{C_{10}H_9NaO_2} + C_{10}H_{10}O_2 = \overset{\text{Valerate of sodium.}}{C_{10}H_9NaO_4} + C_{10}H_{10}.$$

The hydrocarbon $C_{10}H_{10}$ at the instant of formation combines with valeral with the formation of the compound $C_{20}H_{20}O_2$—

$$C_{10}H_{10}O_2 + C_{10}H_{10} = C_{20}H_{20}O_2,$$

and the latter compound, by the action of nascent hydrogen, is partially converted into the compound $C_{20}H_{22}O_2$, isomeric with capric alcohol.

Bertagnini has shown that by heating chloride of acetyl in a sealed tube with benzylic aldehyde to about 120° C. for a number of hours, cinnamic acid is produced.

Here the chloride of acetyl, having a strong attraction for water, at length decomposes the aldehyde in the manner represented by the equation—

$$C_{14}H_6O_2 = C_{14}H_4 + H_2O_2.$$

At the instant of decomposition of the aldehyde chloride of acetyl is converted into acetic acid, and the hydrocarbon $C_{14}H_4$ combines with the acetic acid with the formation of cinnamic acid—

$$C_4H_4O_4 + C_{14}H_4 = \overset{\text{Cinnamic acid.}}{C_{18}H_8O_4}.$$

It appears also that the hydrocarbons $C_{2n}H_{2n+2}$ when in the nascent state may combine with some compounds. This at least appears to be the explanation of the reaction by which Frankland and Duppa have obtained several isomers of leucic acid and its homologues by the action of zinc ethyl and zinc methyl on various oxalic ethers.

Let us take the case first investigated—viz., the action of zinc ethyl on oxalic ether.

To simplify the explanation we will first suppose the reaction to take place on oxalic acid.

In the first place the oxalic acid is reduced to Debus' glyoxalic acid, and a portion of the zinc ethyl is converted into ethylate of zinc—

$$C_4H_2O_8 - O_2 = \overset{\text{Glyoxalic acid.}}{C_4H_2O_6}.$$

Frankland finds that the addition of water is necessary to complete the reaction. By the action of water on zinc ethyl, hydride of ethyl is produced.

$$Zn_2(C_4H_5)_2 + H_2O_2 = Zn_2O_2 + 2C_4H_5H.$$

The hydride of ethyl when in the nascent state combines with the glyoxalic acid with the formation of butylactic acid.

$$C_4H_2O_6 + C_4H_6 = \overset{\text{Butylactic acid.}}{C_8H_8O_6}.$$

We may here observe that Debus has shown that by the action of nascent hydrogen (which is homologous with hydride of ethyl) on glyoxalic acid, it is converted into glycollic acid (which is homologous with butylactic acid). To take now the case of oxalic ether. It is first reduced by the action of the zinc ethyl to ethylglyoxalic ether,

$$C_4O_8(C_4H_5)_2 - O_2 = C_4O_6(C_4H_5)_2,$$

which by combination with nascent hydride of ethyl is converted into ethylbutylactic ether, analogous to ethylactic ether.

Ethylbutylactic acid $C_{12}H_{12}O_6$ is isomeric with leucic acid. A similar explanation applies to the other reactions, as of zinc methyl on oxalate of methyl, &c.

If zinc ethyl were added drop by drop to an aqueous solution of oxalic acid, probably no reduction of the latter would take place; but it would be converted by combination with nascent hydride of ethyl into the acid $C_8H_8O_8$ homologous with glyceric acid $C_6H_6O_8$ and with glyoxylic acid, $C_4H_4O_8$.

If this explanation of the reaction be the true one, the nascent hydrides of methyl, ethyl, &c., produced by the regulated action of water on zinc methyl and zinc ethyl, &c., will be capable of being applied extensively in organic synthesis. Thus, just as by the combination of carbonic anhydride with nascent hydrogen formic acid is produced, so it might be found possible to effect the combination of carbonic anhydride and the nascent hydrides of methyl and ethyl, with the production of acetic and propionic acids. Again, by the combination of nascent C_4H_4 with glyoxal $C_4H_4O_4$, an isomer of butyric acid homologous with Chnrch's isomer of acetic acid* would, perhaps, be produced; also methylethylamine by the combination of nascent C_2H_4 with hydrocyanic acid, &c.

$$2C_2H_4 + C_2NH = \overset{\text{Methylethylamine.}}{C_6H_9N}.$$

I shall not pursue these speculations further; enough has been said to show the extensive developments of which the methods of synthesis enunciated in this paper are capable.

For the continuation of the experiments described in this paper, a grant from the British Association has been placed at my disposal.

The experiments were made in the laboratory of the University of Edinburgh, with the kind consent of Professor Playfair.

Grantham, October 17.

Errata.—The reader is requested to make the following corrections in the portion of Mr. Catton's paper in the CHEMICAL NEWS of October 29:—Page 206.—First column, line 24 (from top), *dele* "A part of." Second column, lines 48 and 49, *for* "carbonic acid," *read* "carbon." Page 207.—First column, line 44, *after* "the residue," *insert the words* "which had a strong sudorific odour." Second column, line 13, *for* "gave," *read* "give." Second column, lines 20, 23, 24, 32, *for a read* 4—*i.e.*, *for* "$C_{12}H_{11}CaO_a.Ca_2O_2$," *read* "$C_{12}H_{11}CaO_4.Ca_2O_2$;" and *for* "$C_{12}H_{11}CaO_a$," *read* "$C_{12}H_{11}CaO_4$."

On Chrysen, by JOHN GALLETLY.

THIS body was first discovered by Lanrent, and is now pretty well known. It is obtained from various sources by destructive distillation, but is probably best known as got from coal tar. It is well described in the latest edition of Fownes' Chemistry as a "pure yellow crystalline powder, which fuses by heat, and sublimes without much decomposition, &c." I have found it also to be a substance which is abundantly obtained by distilling coal at a low temperature. It likewise shows itself in the distillation of most shales. Towards the end of the distillation of the crude oil it is to be observed in the worm pipes, very often in considerable quantities, exactly as when coal tar is distilled. Its composition as obtained from paraffin oil agrees exactly with the formula $C_{12}H_4$ as usually written. I observe this is doubled in Strecker's German edition of Regnault; but form a compound I have prepared of chrysen with picric acid it appears that it ought to be tripled. This compound is easily got by dissolving with heat the chrysen and picric acid in Boghead naphtha, filtering and leaving to cool. It forms groups of long crystalline needles (they may be half an inch long) on the sides of the glass, and of a fine reddish-brown colour. In properties it resembles the analogous compounds got by Fritsche with picric acid and benzol, napthalin and paranaphthaline. The chrysen compound yielded from 30·70 grains 15·39 chrysen equal to 50·1 per cent. The theory for the formula $C_{36}H_{12} + C_{12}H_3(3NO_4)O_2$ requires 49·9 per cent.

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* This isomer of acetic acid would probably be produced by the action of nascent hydrogen on glyoxal.

It will be seen that this is the first term of another series of substances in Kekulé's arrangement of organic bodies, which differs from paranaphthaline by C_8H_2.* The following is a table of these first terms as far as at present known; perhaps the crystallisable benzol is the proper analogue of the higher terms, and from the high melting and distilling point of chrysen, and its leaving charcoal when sublimed, it is not unlikely that a higher hydrocarbon of this class is not to be looked for. The fusing point of chrysen stated in the table is my own determination, and a little higher than its melting point as generally represented.

			Melting points.
Ethylen .	. C_4H_4		
Benzol .	. $C_{12}H_6$	freezes about	. 32°F.
Naphthalin	. $C_{20}H_8$	,,	175°F.
Paranaphthalin	. $C_{28}H_{10}$	,,	416°F.
Chrysen .	. $C_{36}H_{12}$	,,	470°F.

These bodies exhibit a beautiful gradation in their properties. The large crystalline plates of naphthalin when sublimed are not nearly so large in paranaphthalin, and still smaller in chrysen. Paranaphthalin is got in crystals from solution, chrysen only as a fine yellow powder; it may appear crystalline under the microscope. It is the same with regard to solubility; chrysen is very much less soluble than paranaphthalin in any common solvent of hydrocarbons, and the latter much less than naphthalin. The whole of the substances in the table above are likewise similarly acted on by nitric acid, vitriol, chlorine, &c. They all volatilise readily long before they reach their true boiling point, and have likewise the property of being carried much further along the cooling worm pipe than their condensing points would lead us to expect. The volatilising and condensing of this class of bodies is still not well understood.

Ethylen is understood to be obtained more abundantly from coal at a low than at a high temperature. Benzol is known to be got from coal at both temperatures. I have not heard of its being obtained from coal distilled at a black heat, which is said to be a manufacturing process. Naphthalin has only been obtained at high temperatures, so far as we know at present. Paranaphthaline, usually got from coal tar, I believe I have obtained from certain dull-looking cannel coals at a low temperature, but at present cannot present any evidence of this statement. Chrysen is obtained at both temperatures; naphthalin seems to be the only body in the table which a low temperature does not produce, but I hope to be better satisfied on this point before the winter is over.

Laurent's pyren, I am inclined to think, was merely chrysen containing an admixture of paraffin; its composition and properties would agree well with this supposition, and from the difficulty I have sometimes experienced in separating paraffin from chrysen, this is the conclusion I have arrived at. I may state, however, that I have obtained a solid compound from coal distilled at a low temperature, resembling paraffin in appearance, but not melting till near the boiling point of water. It is possible that pyren may be a higher homologue of this body, but I trust to be able to send you soon a more particular account of this substance, and also of some chrysen compounds.

Mandale, Norway.

On the Synthesis of Butyric and Caproic Acids.*

In this and a previous number of the Chemical News will be found a paper by Mr. Catton, "On the Synthesis of Butyric and Caproic Acids."† This paper, which was read at the Bath meeting of the British Association, would form a very important addition to organic chemistry if the result at which its author arrives were properly established.

We are bound, however, to state that the experiments detailed in the paper establish nothing beyond disregard on the part of the author of the ordinary methods and requirements of modern chemistry.

Mr. Catton's way of recognising butyric and caproic [illegible] is as follows:— acids [illegible] a precipitate on adding subacetate of lead

He obtains [illegible] is testing. This precipitate is sus- to the solution be[illegible] decomposed by sulphuretted pended in water and[illegible] resulting liquid then heated hydrogen, filtered, and the[illegible] a current of air. and subjected to the action of [illegible]nds this solution to be

To Mr. Catton's great joy, he fin[illegible] The acid or acids "considerably acid to test paper. [illegible]ic acid, but new thus obtained were, therefore, not acet[illegible] acids produced in the process." [illegible] the process"

It will at once occur to our readers that "[illegible]considerably by which Mr. Catton's solution became "co[illegible]ogen, and acid" was oxidation of the sulphuretted hydr[illegible]ric acid. that one, if not the only "new acid," was sulphu[illegible]" was

This solution, "considerably acid to test paper[illegible], fil- next neutralised with caustic potash, evaporated[illegible], is tered, and mixed with solution of nitrate of silve[illegible] which it determined a precipitate of silver salt. T[illegible] determinations of silver in this precipitate gave 52·7[illegible] per cent., and "52·30002" per cent. of silver (the lat[illegible] determination being made on 41 milligrammes of salt).

The quantity of silver contained in pure butyrate of silver is 55·38 per cent.

Mr. Catton's conclusion from all this is "that the acid solutions consisted principally of an acid having the same molecular weight as butyric acid mixed with acids containing a higher percentage of carbon."

It is almost unnecessary to remark that these facts by themselves—in the absence of any proof that the organic acid was volatile or had an acid reaction, and in the absence of an organic analysis, and of all data for determining whether the supposed organic acid was single or a multitude of acids—prove the presence of any one of several thousand possible organic acids quite as much as the presence of butyric acid.

Arrived at this stage of the investigation, the idea seems to strike Mr. Catton that it might be well to attempt a separation of these acids. He prepares a fresh lot of the solution assumed to contain butyric acid, makes a lead salt as before, and decomposes with sulphuretted hydrogen.

After saturating the acid with lime, and taking steps to ensure the absence of excess of lime, he evaporates down the solution. During this evaporation, he is surprised to observe that a precipitate (probably consisting, at least in part, of sulphate of lime) makes its appearance. Ultimately he gets a lime salt, and determines the percentage of calcium to be 19·3212. This determination he makes by converting the salt into a carbonate. After making the remark that butyrate of calcium contains 18·6915 per cent. of calcium, he proceeds:—

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* I do not know whether it has been remarked that pyridine, $C_{10}H_5N$, the lowest number of its series, differs from chinoline, $C_{18}H_7N$, the lowest of its series also, by C_8H_2.

* Communicated.

† See page 205, et seq.

"The excess in the quantity of carbonate found was, no doubt, due to the presence of a small quantity of carbon, which would be expelled on heating the carbonate with concentrated sulphuric acid, and then converting it into sulphate." Operating in this manner, he reduced his percentage of calcium to 18·6636.

Now, every chemist knows that an estimation of lime made as carbonate is liable to contain, not excess of carbonic acid, but excess of lime.

In fine, this paper of Mr. Catton's, although read before the British Association, is utterly destitute of any scientific value.

We have deemed it to be necessary to make these remarks partly on account of a circumstance which has recently come to our knowledge. The *Jahresbericht* for 1863 records a research of Mr. Catton's on a kindred subject and of a kindred character.

PHARMACY, TOXICOLOGY, &c.

On Commercial Bromide of Potassium,
by W. T. Fewtrell.

The use of bromide of potassium as a remedial agent has of late greatly increased, and it is now administered in very large doses. Recently it has been observed that the use of the remedy has been occasionally followed by symptoms of *iodism*, or the peculiar affections which are sometimes produced by excessive doses of iodine or iodide of potassium. As no such effects have been observed to follow the exhibition of bromide of potassium, the circumstance gave rise to a suspicion that some specimens of the bromide are *adulterated* (the present difference in the price of bromine and iodine justifies this term) with iodide of potassium. I accordingly procured a sample of the salt for examination. It was labelled "Bromide of Potassium (French)." It was a well crystallised salt, the crystals being perhaps rather more opaque than those of the pure bromide. A qualitative examination at once revealed the presence of a considerable proportion of iodine; and quantitative analysis showed that the amount present corresponded to 20 per cent. of iodide of potassium. This adulteration deserves the serious attention of pharmaceutists and medical men, who will do well to test all samples of bromide they receive. A solution of the salt mixed with a little mucilage of starch should not exhibit any blue colour on the addition of solution of chlorine.

Indestructible Writing.—Lucas proposes for this purpose an ink composed of 20 grains of sugar dissolved in 30 grains of water, to which is added a few drops of concentrated sulphuric acid. Upon heating this mixture the sugar becomes carbonised, and when applied to the paper leaves a coating of carbon which cannot be washed off. This stain is rendered more permanent by the decomposing action of the acid itself upon the paper, and thus made, it resists the action of chemical agents. The paper should, after drying, be passed through a weak alkaline solution to remove excess of acid.—*Breslauer Gewerbebl. N. Jahrb. Ph.* xx. 330.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 3.

Professor A. W. Williamson, Ph.D., F.R.S., *President, in the Chair.*

In concluding our report of this meeting we present an abstract of the paper read by Mr. William Baker, of Sheffield, which appeared to excite a good deal of interest, and led to further discussion. The communication was entitled, "*On the Existence of Nitrogen in Steel,*" by Graham Stuart, F.G.S., F.C.S., and William Baker, F.C.S., Associate of the Royal School of Mines, the authors having proposed to undertake some experiments with the view of procuring data towards the solution of the vexed question "Is nitrogen an essential constituent of steel?" and, if so, for the purpose of showing whether its presence in greater or less quantity could he held to account for the difference in quality of various kinds of steel. With this intention the authors operated upon a number of characteristic samples both of iron and steel, including cast steel, blister steel, and the well-known mark ♔ JB., Bessemer steel; *spiegeleisen*, a kind of iron now used to a considerable extent for further carburising steel during the ordinary process of refining; wrought iron of English manufacture, and the same converted into steel by being heated to redness in a current of carbonic oxide gas. The form of apparatus employed has been varied considerably during the progress of the experiments, but the general plan of investigation has remained uniform throughout, and the alterations have only been intended to secure more completely the fulfilment of those conditions which were found to be absolutely indispensable to obtaining a correct result. Those conditions may be briefly stated as consisting either in the total exclusion of nitrogen, in every shape and form, from the apparatus and the gas used, or, as was found sometimes even more satisfactory, in the employment of such a modification of the apparatus as would admit of estimating what quantity of the nitrogen obtained was due to any sources other than the steel under examination. The general method of experimenting was as follows:—Hydrogen purified, and more or less dried, was passed over the steel or other substance under examination, heated to full redness, and was then conducted into a Will's nitrogen apparatus, where the ammonia generated by its passage over the red-hot steel was absorbed in a standard solution of sulphuric acid, and its amount afterwards estimated by volumetric analysis. It was then, of course, easy to deduce by calculation the quantity of nitrogen contained in the steel. In the first experiments, no means were taken specially to exclude or make allowance for the nitrogen that might be present as air, either mixed with the hydrogen in the gasometer or in the tubes of the apparatus before the commencement of the experiment; reliance being placed in the former case upon the hydrogen being prepared with such care as to insure its purity, and in the latter upon the gas being passed through the apparatus for a sufficiently long interval of time to sweep out the air contained in it previous to the experiment being commenced. The above remarks apply particularly to the experiments numbered 1 to 11 inclusive, in which the apparatus used consisted merely of

—1. A solution of potassa; 2. Column of pumice saturated with sulphuric acid; 3. A U drying tube of chloride of calcium; 4. The analysis tube; 5. Will's nitrogen bulbs charged with standard acid. The steel in all the experiments was used either in the form of fine powder (passed through a muslin sieve) filings, grains (the size of ordinary shot); or strips, about 3 to 4 inches long, $\frac{1}{4}$ inch to $\frac{3}{8}$ inch wide, and about $\frac{1}{50}$th to $\frac{1}{100}$th inch in thickness. The passage of the gas through the potash-bulbs varied from the rate of 50 to 150 bubbles per minute, and was continued after the heat was withdrawn until the assay tube was quite cold. Table I. exhibits the result of the first eleven experiments just mentioned; by a reference to which it will be noticed that in all these instances, excepting No. 2, nitrogen was obtained, though varying in quantity from ·007 to ·068 per cent.

TABLE I.

No. of experiment.	Description and state of steel employed.	Quantity of steel.	Duration of experiment.	N. obtained, per cent.
1.	JB. Blister steel, in grains	50·000 grm.	1 hour.	·068
2.	Ditto	25·000 „	2 „	·000
3.	Ditto	25·000 „	2 „	·0193
6.	Ditto	33·3345 „	$2\frac{1}{2}$ „	·020
7.	Cast-steel, in strips ..	37·9307 „	$1\frac{3}{4}$ „	·027
8.	Ditto	18·6485 „	$3\frac{1}{2}$ „	·018
9.	Bessemer steel, in filings	50·000 „	2 „	·011
11.	Ditto	55·723 „	$1\frac{1}{2}$ „	·007

These experiments were considered as merely preliminary, and, judging from the experience afterwards obtained, the authors reject altogether Nos. 1, 3, 6, and 7, from the nitrogen obtained being, at all events, in part, derived from other sources than the steel; most probably from some air lingering in the apparatus when the experiment was commenced; and when the comparatively large quantities of nitrogen obtained are taken into account, there can be but little doubt that this source of error vitiated the results in all these instances. Experiment No. 2 demands a special notice. It seems to have given what must now be looked upon as an accurate result; however, as it was only the second experiment of the kind that the authors had made, they did not feel justified in laying any very great stress upon it, although, on referring to their note-book, they could not find any further reason to doubt its accuracy. In experiments Nos. 8, 9, and 11 the amount of nitrogen found had materially decreased. This may probably have arisen from the precautions requisite to insure an accurate result becoming better understood, and especially to extra care being taken in preparing the hydrogen, and in driving out the air from the apparatus more completely before commencing the experiments. On comparing all these experiments generally together, a gradual but unmistakeable decrease in the amount of nitrogen was at once apparent. This appeared strange, and aroused a suspicion that possibly much, if not all of it, might be due to other sources than the metal under examination, and it was evident that more careful experiments were necessary to arrive at a perfectly correct result. It was then determined to try if the nitrogen present in the apparatus could not be entirely removed, so as to insure the hydrogen arriving at the assay tube in a state of absolute freedom from this impurity. The best method of doing this seemed to be to convert it into ammonia, and to absorb it in this state by dilute acid, and the apparatus was accordingly modified thus:—

1. Flask containing potash as before.
2. Tube filled with soda lime at a red heat, and about six inches in length.
3. Dilute sulphuric acid.
4. Assay tube.
5. Will's nitrogen bulbs filled with standard acid.

The distance between the sulphuric acid and the steel was made as short as possible, with the view of reducing to a minimum the quantity of air it would contain, and the further precaution was taken of passing the gas over the soda-lime for some time before the steel was heated. It will thus be seen that if any nitrogen was present, either in the hydrogen or in the apparatus it would become converted into ammonia by passing over the soda-lime, which passing onwards would be absorbed by the sulphuric acid. There would now remain only the small space above the liquid in the sulphuric acid bottle, and the short and narrow tube between it and the assay-tube in which any air could lodge, to vitiate the results. With this arrangement, experiments 13 to 17 were made. No. 13 and 14 were made upon cast steel in thin strips similar to those previously described, and Nos. 15 and 17 upon *spiegeleisen* crushed to powder in a steel mortar and passed through a fine muslin sieve. It will be noticed by a reference to table No. 2 that considerable quantities of these substances were used, but in only one case was any nitrogen detected. This was in No. 15, upon spiegeleisen, but there seems to be some doubt respecting the accuracy of this experiment and it appeared likely that the assay-tube was heated before the air was entirely expelled from it, and as in the subsequent experiments upon the same substance none gave any nitrogen whatever, it is probable that this or some other error must have crept in.

TABLE II.

No. of experiment.	Kind and state of substance employed.	Quantity used.	Duration of experiment.	N. obtained, per cent.
13.	Cast steel in strips . .	27·081 grms.	1 hour	·000
14.	Do. do. . . .	26·706 „	?	·000
15	Spiegeleisen in fine powder	20·583 „	3 hours	·015
17.	Do. do.	20·000 „	1 hour	·000

In all these experiments the gas issuing from the soda-lime tube was tested for ammonia by placing small pieces of reddened litmus paper in the narrow tube leading from it into the sulphuric acid bottle. They invariably gave indications of its presence, and traces of it could be found even after the hydrogen had been passing through for more than an hour. The assay-tube was never heated until these traces had entirely disappeared. In the next series of experiments that were made, the soda-lime tube was dispensed with, and no means were taken to absorb the nitrogen in the apparatus. The hydrogen was prepared with every possible precaution, however, and was passed direct from the gas-holder into the assay-tube without any intervening apparatus except a wash-bottle filled as full as practicable with a solution of protosulphate of iron, made slightly alkaline with potash. As short an apparatus as possible was used, and the hydrogen passed through it for a long time before heat was applied to the assay-tube, the object being to reduce the amount of air contained in the apparatus to the least possible quantity, and to completely sweep it out, so as to prevent the nitrogen it contained interfering with the result. The protosulphate of iron was intended to absorb any oxygen that might be present, it being frequently found that the steel was slightly oxidised when the experiment was ended. It was replaced for experiments Nos. 51 and 52 by a solution of oxide of lead in potash. This was used to absorb hydrosulphuric acid, a small quantity of which was given off during some of the experiments. This method was found to answer very well in practice, although, of course, open to the objections which have been stated before; very great care was, however, requisite in making the experiments, but when sufficient attention was given, the results might be relied upon. In table No. 3 a detailed account of the experiments made with this arrangement is given; a glance at it will show that in the whole series no amount of nitrogen was obtained that could be considered of any importance, even with the possible chance of the errors previously pointed out. The authors submit that th negative results obtained in these instances are very stron evidence that nitrogen is not an essential constituent of steel.

TABLE III.

No. of experiment.	Kind and state of steel employed.	Quantity used.	Duration of experiment.	N. obtained, per cent.
19.	Spiegeleisen in fine powder	7·190 grm.	¾ hours.	·000
20.	Cast steel in strips . . .	15·536 ,,	3½ ,,	·000
21.	Iron in strips	25·713 ,,	2 ,,	·0051
23.	Cast steel in filings . . .	14·621 ,,	6 ,,	·000
24.	Do. do.	15·077 ,,	3 ,,	·000
35.	Do. do.	40·057 ,,	3 ,,	·0023
51.	Steel made by heating iron in CO.	8·005 ,,	2 ,,	·0015
52.	Spiegeleisen in grains . .	80·000 ,,	4 ,,	·000

In the succeeding experiments an important alteration was made in the apparatus, which requires to be shortly described. Two tubes, one containing the steel to be operated upon mixed with soda-lime, and the other containing soda lime only, were placed side by side in the same furnace, and heated to the same temperature, whilst the hydrogen was passed from the same gas-holder through both, the current being so regulated that an equal quantity passed through each tube in a given time. Previously to its entering the tubes the hydrogen was washed by passing successively through solution of potassa and dilute sulphuric acid, and in some cases was partially dried by passing through concentrated sulphuric acid immediately before its entrance into the steel and soda-lime tubes. The first of these was made upon cast steel filings, 6·355 grm. of which were taken and intimately mixed with 6·3 grm. of soda-lime, the same weight of soda-lime alone being placed in the second tube. Both were heated to full redness for two and a-half hours. No nitrogen was obtained. The whole of the series were made in a precisely similar manner, Nos. 25, 30, and 36 upon cast steel in filings, and Nos. 32, 33, 34, and 37 upon JB. blister steel, and iron of the same brand. A reference to the following table will show the results obtained:—

TABLE IV.

No. of Experiment.	Quantity of steel employed.	Kind and state of steel employed.	Quantity of soda-lime mixed with the steel.	Duration of experiment.	N. obtained per cent.
25.	6·355	Cast steel in filings. . . .	6·3	2½ hours	·000
30.	5·000	Do. do.	5·0	6½ ,,	·000
32.	5·091	JB. Blister steel in filings	5·0	4½ ,,	·000
33.	10·117	Iron do. .	5·0	3 ,,	·000
34.	9·980	Blister steel.	5·3	2 ,,	·010
36.	21·040	Cast steel in filings. . . .	15·0	2 ,,	·0009
37.	19·456	JB. Blister steel in filings	6·7	1 ,,	·0040

It was invariably found that the greater part of the nitrogen, in those cases where any was obtained, was given off in the early part of the operation, and that towards the end no indication could be found. It appeared very probable from this circumstance that in those instances the nitrogen was supplied by the air in the apparatus. Having given a full description of the methods of experimenting, the authors next direct attention to the different kinds of steel and iron employed, and the quantity of nitrogen obtained from each. Excluding, for the reasons previously given, the first five experiments, there are four made upon JB. blister steel, and iron. Of these, two, Nos. 32 and 33, gave absolutely no nitrogen; whilst the others, Nos. 34 and 37, gave only ·004 and ·010 per cent., quantities which, in their opinion, were due to the sources of error before mentioned. Taking the average, ·0036 per cent. is obtained, an amount which is too small to be considered of any moment. These experiments were all made upon the same sample in the state of filings. Next follow ten experiments upon cast steel. These were made partly on cast steel in the form of strips and partly as filings. In these a remarkable unanimity is observable in the results, for out of the ten eight gave no indications of nitrogen whatever, and the other two only ·018 and ·0023 per cent., the average of the whole being ·002 per cent., an amount which may be considered as quite inappreciable in influencing the quality of steel. Then come two experiments on Bessemer steel; both these show nitrogen—one to the amount of ·007 per cent., and the other ·011 per cent. In both these cases large quantities (50 to 55 grms.) were used, and it may be possible that this peculiar kind of steel contains some small quantity of nitrogen; though, even in this case, it would not affect its quality, being most likely an accidental constituent, formed during the process of manufacture, from the stream of air driven through the molten iron forming some compound in it analogous to that which nitrogen forms with titanium, and which is so often found in crude pig-irons. Then follow four experiments upon spiegeleisen, which show, with one exception, a total absence of nitrogen. One of these must be particularly alluded to, viz., No. 52, in which 80 grm. were submitted to experiment for four hours. At the end of this time it was found that no nitrogen whatever had been eliminated. The authors look upon this as being one of the best and most conclusive experiments they have made, and its evidence is very strong in favour of the conclusion that nitrogen is not present essentially in steel. The two experiments which remain to be mentioned were made upon iron of English manufacture, of very soft quality, and the same converted into steel by heating to full redness in a current of carbonic oxide. In both cases the results were so small as to indicate mere traces of no importance. After reviewing the whole of the experimental results which have been described, the authors adopt the conclusion that nitrogen does not exist either in steel or in iron as an essential constituent, and cannot, therefore, be made use of to explain the different commercial qualities of those substances. Taking the average of the whole series of experiments, the proportion of nitrogen amounts only to ·0033 per cent., a result which the authors consider to be of no practical value. The adhesion of air to the surface of the steel would be sufficient to explain the amounts which in some instances were obtained, and in experiments carried to such a nicety, this source of error must not be overlooked, and, taken in addition to that arising from the air remaining in the apparatus, small as its amount may have been, would be, nevertheless, quite sufficient to account fully for all the nitrogen obtained. It was not to be expected that in a long series of experiments every one should be equally successful, but they have published the results, good and bad, as they occurred, rejecting only such as contained a manifest and palpable error; and, in summing up the whole of the evidence, the authors give it as their opinion that nitrogen is not an essential constituent of steel or iron, that it very rarely exists in them even as an accidental constituent, and that it has nothing whatever to do with the respective qualities of different samples of those substances.

The PRESIDENT, in inviting discussion upon the subject of Mr. Baker's communication, referred briefly to the difficult nature of the investigation, and the necessity for using every precaution in the conduct of such experiments.

Mr. PERKIN asked the lecturer whether he had assured himself that hydrogen was really capable of abstracting nitrogen from iron or steel; for even supposing the metals contained this element as an essential ingredient, he doubted whether the affinities of hydrogen and nitrogen were such as to permit of the formation of ammonia at a high temperature.

Professor WANKLYN mentioned the result of some experiments performed by Mr. Dittmar, of Edinburgh, upon MM. Will and Varrentrap's method of estimating nitrogen. According to his experience, it was shown that ammonia was resolved into its constituent gases by the action of a degree of temperature not much higher than that usually employed in the soda-lime process.

Dr. Miller said there was no doubt regarding the possibility of decomposing ammonia by heat; this happened especially when a current of the gas was passed over red-hot iron filings.

Professor Church alluded to an observation of M. Wöhler, who found that the nitride of boron might be heated for any length of time in a current of pure dry hydrogen without suffering decomposition; but if the gas be passed conjointly with the vapour of water ammonia was at once formed.

Mr. Baker replied by asserting his belief that steel was permeable by gases at a high temperature, and that if the specimens of metal, whether in filings or rolled strips, had contained nitrogen, such constituent would have been expelled in the form of ammonia. His views partly received support from the well-known fact that it was possible to convert iron into true steel by heating in a current of carbonic oxide, carburetted hydrogen, or cyanogen gas. He would remind the Society of the circumstance that his experiments were merely in repetition of those of M. Fremy, and that they were negative in their character. He had himself endeavoured to produce a nitride of iron for the purpose of investigating its properties, but hitherto without result. The onus lay with those who stated that nitrogen was contained in steel to prove that such a combination was really decomposed by hydrogen. For himself, he believed that the nitrogen had been derived from other sources extraneous to the metal operated upon.

The President said there could be no doubt that a kind of cementation went on at a high temperature, and that the steel was really permeable to gases. But, supposing even the nitrogen to be removed, he doubted whether it would take the form of ammonia. He had himself remarked the facility with which ammonia was decomposed by heat when attempting to employ iron tubes in organic analysis; but owing to a loss of nitrogen, he had been compelled to resort again to the use of the ordinary glass tubes.

LECTURES ON CHEMICAL PHILOSOPHY.—VI.

Delivered at the College of France, by M. A. Wurtz.

The Theory of Types.

(*Continued from page 236.*)

Williamson has shown that the views before mentioned may be extended to acids, to salts, to compound ethers, &c. Benzoic acid, for example, may be regarded as water modified by substitution. We can form it, in fact, in the following way:—

$$\left.\begin{matrix}\mathrm{H}\\ \mathrm{H}\end{matrix}\right\}O + \underbrace{\overline{\mathrm{Bz}}\mathrm{Cl}}_{\text{Chloride of benzoyle.}} = \mathrm{HCl} + \underbrace{\left.\begin{matrix}\overline{\mathrm{Bz}}\\ \mathrm{H}\end{matrix}\right\}O.}_{\text{Benzoic acid.}}$$

Benzoate of potassium, then, is nothing more than the acid in which K is substituted for H. In benzoate of silver, Ag is substituted for H.

If we treat benzoate of silver by iodide of ethyl, C_2H_5I, we form a benzoic ether—

$$\left.\begin{matrix}\overline{\mathrm{Bz}}\\ \mathrm{Ag}\end{matrix}\right\}O + C_2H_5I = \mathrm{AgI} + \left.\begin{matrix}\overline{\mathrm{Bz}}\\ C_2H_5\end{matrix}\right\}O,$$

the formula of which is similar to that of the ether,

$$\left.\begin{matrix}C_2H_5\\ CH_3\end{matrix}\right\}O.$$

We may here collect together, in the following table, the whole of these typical analogies founded upon experiment:—

$$\text{Type:}\quad \left.\begin{matrix}\mathrm{H}\\ \mathrm{H}\end{matrix}\right\}O$$

Hydrates.	*Oxides.*	*Salts.*
$\left.\begin{matrix}\mathrm{K}\\ \mathrm{H}\end{matrix}\right\}O$ Hydrate of potassium.	$\left.\begin{matrix}\mathrm{K}\\ \mathrm{K}\end{matrix}\right\}O$ Oxide of potassium.	$\left.\begin{matrix}NO_2\\ \mathrm{K}\end{matrix}\right\}O$ Nitrate of potassium.
$\left.\begin{matrix}\mathrm{Na}\\ \mathrm{H}\end{matrix}\right\}O$ Hydrate of sodium.	$\left.\begin{matrix}\mathrm{Ag}\\ \mathrm{Ag}\end{matrix}\right\}O$ Oxide of silver.	$\left.\begin{matrix}CO\\ \mathrm{K}\end{matrix}\right\}O$ Carbonate of potassium.
$\left.\begin{matrix}CH_3\\ \mathrm{H}\end{matrix}\right\}O$ Hydrate of methyl.	$\left.\begin{matrix}CH_3\\ CH_3\end{matrix}\right\}O$ Oxide of methyl.	$\left.\begin{matrix}C_2H_3O\\ \mathrm{Na}\end{matrix}\right\}O$ Acetate of sodium.
$\left.\begin{matrix}C_2H_5\\ \mathrm{H}\end{matrix}\right\}O$ Hydrate of ethyl.	$\left.\begin{matrix}C_2H_5\\ CH_3\end{matrix}\right\}O$ Oxide of ethyl and methyl.	*Compound Ethers.* $\left.\begin{matrix}NO_2\\ C_2H_5\end{matrix}\right\}O$ Nitrate of ethyl.
Acids. $\left.\begin{matrix}NO_2\\ \mathrm{H}\end{matrix}\right\}O$ Nitric acid.	$\left.\begin{matrix}C_2H_5\\ C_2H_5\end{matrix}\right\}O$ Oxide of ethyl.	$\left.\begin{matrix}C_2H_3O\\ C_2H_5\end{matrix}\right\}O$ Acetate of ethyl.
$\left.\begin{matrix}C_2H_3O\\ \mathrm{H}\end{matrix}\right\}O$ Acetic acid.	$\left.\begin{matrix}C_2H_5\\ C_5H_{11}\end{matrix}\right\}O$ Oxide of ethyl and amyl.	

Gerhardt generalised this opinion, and brought new proofs in support of it. He had before asserted that anhydrous monobasic acids could not exist, seeing that the molecule of normal acids did not contain the elements necessary to form a molecule of water, which would have to be separated. He had not foreseen that these acids might be formed by the union of two molecules of the hydrated acid, a molecule of water being eliminated. A brilliant experiment, however, taught him that it must be so. By treating chloride of acetyle with acetate of sodium, he obtained acetic anhydride—

$$\left.\begin{matrix}C_2H_3O\\ C_2H_3O\end{matrix}\right\}O.$$

$$\underbrace{\left.\begin{matrix}C_2H_3O\\ \mathrm{Na}\end{matrix}\right\}O}_{\text{Acetate of sodium.}} + \underbrace{\left.\begin{matrix}C_2H_3O\\ \mathrm{Cl}\end{matrix}\right\}}_{\text{Chloride of acetyle.}} = \left.\begin{matrix}\mathrm{Cl}\\ \mathrm{Na}\end{matrix}\right\} + \underbrace{\left.\begin{matrix}C_2H_3O\\ C_2H_3O\end{matrix}\right\}O.}_{\text{Acetic anhydride.}}$$

We know, further, that hydrated acetic acid may be formed by the action of water upon chloride of acetyle.

$$\left.\begin{matrix}\mathrm{H}\\ \mathrm{H}\end{matrix}\right\}O + \underbrace{\left.\begin{matrix}C_2H_3O\\ \mathrm{Cl}\end{matrix}\right\}}_{\text{Chloride of acetyle.}} = \left.\begin{matrix}\mathrm{Cl}\\ \mathrm{H}\end{matrix}\right\} + \underbrace{\left.\begin{matrix}C_2H_3O\\ \mathrm{H}\end{matrix}\right\}O.}_{\text{Acetic acid.}}$$

These reactions show that hydrated acetic acid and acetic anhydride are connected with water by a direct relationship.

Besides the water type, Gerhardt created the *hydrogen* type, under which he classed most of the metals, the organic radicals, aldehydes, acetones, &c.

$$\text{Type:}\ \left.\begin{matrix}\mathrm{H}\\ \mathrm{H}\end{matrix}\right\}$$

Elements.	*Radicals.*	*Aldehydes, acetones.*
$\left.\begin{matrix}\mathrm{Cl}\\ \mathrm{Cl}\end{matrix}\right\}$ Chlorine.	$\left.\begin{matrix}\mathrm{Cy}\\ \mathrm{Cy}\end{matrix}\right\}$ Cyanogen.	$\left.\begin{matrix}C_2H_3O\\ \mathrm{H}\end{matrix}\right\}$ Hydride of acetyle (aldehyde).
$\left.\begin{matrix}\mathrm{Br}\\ \mathrm{Br}\end{matrix}\right\}$ Bromine.	$\left.\begin{matrix}CH_3\\ CH_3\end{matrix}\right\}$ Methyl.	$\left.\begin{matrix}C_2H_3O\\ CH_3\end{matrix}\right\}$ Methylide of acetyle (acetone).
$\left.\begin{matrix}\mathrm{K}\\ \mathrm{K}\end{matrix}\right\}$ Potassium.	$\left.\begin{matrix}CH_3\\ \mathrm{H}\end{matrix}\right\}$ Hydride of methyl.	$\left.\begin{matrix}C_7H_5O\\ \mathrm{H}\end{matrix}\right\}$ Hydride of benzoyle.
$\left.\begin{matrix}\mathrm{Ag}\\ \mathrm{Ag}\end{matrix}\right\}$ Silver.	$\left.\begin{matrix}C_2H_5\\ C_2H_5\end{matrix}\right\}$ Ethyl.	$\left.\begin{matrix}C_7H_5O\\ C_6H_5\end{matrix}\right\}$ Phenylide of benzoyle

Under the hydrochloric acid type,

$$\left.\begin{matrix}H\\Cl\end{matrix}\right\}$$

which chemists to-day confound with the hydrogen type,

$$\left.\begin{matrix}H\\H\end{matrix}\right\}$$

Gerhardt classed the chlorides, bromides, iodides, &c., both organic and mineral. It is needless to insist on the analogy of all these compounds.

Passing to the *ammonia type*, we may remark that Gerhardt considerably extended it. Before him, the bodies connected with this type were limited to the compound ammonias and the alkaloids in general; ethylamine, for example, was represented as

$$\left.\begin{matrix}C_2H_5\\H\\H\end{matrix}\right\} N,$$

ammonia being

$$\left.\begin{matrix}H\\H\\H\end{matrix}\right\} N.$$

Gerhardt brought the amides under the same type. According to him these only differ from amines by the oxygenated nature of the radical. Ethylamine is

$$\left.\begin{matrix}C_2H_5\\H\\H\end{matrix}\right\} N,$$

and acetamide is

$$\left.\begin{matrix}C_2H_3O\\H\\H\end{matrix}\right\} N.$$

The first of these bodies is a powerful base, the second is a neutral body, which proves that the properties of a body do not depend upon molecular arrangement only, but, beyond this, are a natural function of the elementary atoms. The influence of oxygen upon the properties of bodies which contain it are in this case clearly shown. Ethylated ammonia, which does not contain oxygen, is strongly basic; acetylated ammonia, in which the negative oxygen takes the place of H_2, is neutral. Gerhardt has since described acid ammonias. According as discoveries followed one another, and the facts were elucidated, this theory has been developed and extended. Before we end this historical *exposé*, we have yet to mention one important point.

Conceiving that it is impossible to bring under the simple type,

$$\left.\begin{matrix}H\\H\end{matrix}\right\} O$$

the molecule of polybasic acids, Williamson thought that it would be convenient to adopt types resulting from the condensation of several molecules of water. If we take chloride of sulphuryle $(SO_2)''\ Cl_2$,* we find that two molecules of water,

$$\left.\begin{matrix}H_2\\H_2\end{matrix}\right\} O_2$$

are necessary to decompose it. We shall then have—

$$\underbrace{(SO_2)'',Cl_2}_{\text{Chloride of Sulphuryle.}} + \left.\begin{matrix}H_2\\H_2\end{matrix}\right\} O_2 = H_2Cl_2 + \underbrace{\left.\begin{matrix}(SO_2)''\\H_2\end{matrix}\right\} O_2}_{\text{Sulphuric Acid.}}.$$

We see by this that sulphuric acid is derived from two molecules of water—that is to say, it belongs to the type of doubly condensed water. This acid is diatomic, because its radical, SO_2, is substituted for H_2, or, in other words, possesses a substitution value equal to H_2.

This idea is the origin of the theory of condensed types, of which we shall speak in a subsequent lecture.

ACADEMY OF SCIENCES.

November 7.

Some very interesting and important memoirs, which do not come quite within our province, were read at this meeting of the Academy, and of which we need only mention the titles. One of these was by M. Tresca "*On the flow of Solid Bodies Submitted to Strong Pressure.*" The results of numerous experiments showed the author that, without undergoing any change of state, solid bodies flowed from an orifice in exactly the same way as liquids when sufficient pressure was applied to them. He described the apparatus employed, and the materials experimented with, which were the soft metals and ceramic pastes. The results it was said went to prove the unity of the constitution of all matter, showing that masses of the most solid metals are formed of separate and mobile molecules. Another important communication was a description by M. Maissoneuve of a "*New Instrument for Crushing Stones in the Bladder and Extracting the Fragments.*" The author calls his instrument the *lithexère*, or stone extractor; it will no doubt attract the attention of English surgeons.

Among the papers specially within our province we may notice one by M. Weil, "*On New Processes for Covering Metals with Firmly Adherent and Bright Layers of Other Metals.*" The method consists in dipping the metal to be coated in a saline solution of the metal to be deposited rendered distinctly alkaline with potash or soda, and mixed with some organic matter, such as tartaric acid or glycerine. At the same time, it is necessary in some cases to set up a weak voltaic current by keeping a piece of zinc or lead in contact with the metal. In this way the author obtains a firm layer of copper on iron and steel, and procures various and beautiful effects according to the thickness of the copper deposited. Silver, nickel, and other metals can be applied in the same way. The process, it will be seen, is susceptible of numerous applications. A curious fact mentioned is that a clean surface of copper may be coated with zinc by placing the two metals in contact in a solution of caustic soda or potash. In the cold the deposit of zinc takes place slowly, but at 100° it is effected rapidly.

M. Lamy contributed a paper "*On Thallic Alcohols,*" which we shall translate at length. At present we may remind our readers that M. Lamy has already described a compound of thallium and ethylic alcohol, a very dense liquid of great refractive power. In the hope of obtaining a still denser and more refractive body, he sought for a compound of *thallium and amylic alcohol;* this liquid, however turned out to be lighter than the ethylic compound. He then formed *methyl-thallic alcohol;* this is a solid body at ordinary temperatures. The general properties of these compounds, and the methods by which they were prepared, will be described at length in an early number.

M. Le Guen presented a note "*On Tungsten Steel.*" The author's experiments go to show that the addition of tungsten up to 2½ per cent. greatly increases the tenacity of the steel. The effect, however, is rather less when the iron is cemented with wood charcoal than when coke is used.

In a note "*On the Production of Formamide by means of Formiates and Oxalates,*" M. Lorin shows that formamide may be obtained by the distillation of chloride of ammonium and a formiate, the sodic formiate more particularly; and further, that the same body is produced in the careful distillation of acid or neutral oxalate of ammonia. The formamide will be found among the liquids which pass above 130° C.

Among the papers which may be of interest to our medical readers are a description, by M. Guyon, of a parasitic worm, which makes itself a home for a time under the conjunctiva of negroes, but which, according to the author, is a sort of bird of passage, moving about according to its necessities. The paper will be of interest to surgeons and naturalists. M. Ponchet announced his "*Discovery of Bacteries and Vibros in Bronchial Mucus, and Discharges from the Nose and Ear.*" Lastly, M. Decaisne presented a note "*On the Effects of Tobacco-smoking on Children,*" ascribing to that indulgence the chloro-anæmic condition he constantly remarks in French boys.

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* By the signs ′, ″, ‴, ⁗, ″‴, the author as usual indicates monatomicity, diatomicity, triatomicity, &c.

NOTICES OF BOOKS.

Annalen der Chemie und Pharmacie. October, 1864.

We have in this journal several papers which have already appeared in the Chemical News, including Marignac's "*Researches on the Silico-tungstic Acids,*" Pisani's "*Analysis of Pollux,*" and Mr. Bassett's paper "*On Quadribasic Carbonate of Ethyl,*" as well as papers by Wurtz, Berthelot, and others from the *Comptes Rendus.* Of the original papers, the most important is by Heintz "*On Ethyl-diglycolamidic Acid, and some Compounds of Ethyl-glycocol.*" We must refer readers interested in these bodies to the original paper. Another original contribution is by Braun, "*On the so-called Xanthocobalt Compounds.*" The author differs from Gibbs and Genth as to the constitution of the ammoniacal compounds of cobalt to which they gave the above name, and gives analyses and reasons in support of his own views. Dr. Wickelhaus has a communication in which he shows that the acid obtained by the action of sodium amalgam on *aconitic acid* is identical with the acid obtained by Mr. Simpson from the cyanide of allyl, and which Kekulé has named *carballylic acid.* The formula of this acid is $\Theta_6H_8\Theta_6$. It is soluble in water, alcohol, and ether: the salts could not be obtained crystallised. The reaction with salts of peroxide of iron is peculiar. At first only a cloudiness appears, but on long standing, or on boiling, a bulky precipitate forms, which analysis seemed to prove a mixture of a bibasic and tribasic salt. Submitted to a high temperature, the acid at first sublimed, but about 200° it lost water, and left in the retort a crystalline residue, which again attracted water. We have also in this number the continuation of a series of papers giving an account of original researches made in the laboratory at Marburg. The first is "*On the Action of Nascent Hydrogen on Benzoic Acid,*" by Dr. Herrmann. On distilling an excess of benzoic acid in water with sodium amalgam, a distillate is obtained, which smells of bitter almond oil, and contains an oil which partly settles at the bottom and partly remains suspended in small drops. By extracting the alkaline residue with ether, a dense aromatic oil is separated, which in a short time becomes a crystalline mass. By treating the residue exhausted by ether with hydrochloric acid a yellowish offensive oily acid is separated, which can be isolated with ether. The smell of the distillate was, of course, due to the presence of bitter almond oil; the oily drops separated from it on analysis gave results which corresponded with the formula of hydrated oxide of tolyl, $C_{14}H_8O_2$. The crystalline mass extracted from the alkaline residue by ether gave results which accord with the formula $C_{14}H_7O_2$, or $C_{28}H_{14}O_4$. On heating this body with concentrated sulphuric acid it changed into a crystalline mass, which, on dry distillation, was completely converted into bitter almond oil. On distillation in a stream of carbonic acid it gave a crystalline sublimate, which may be benzoic acid. The body appears to be isomeric with *hydrobenzoin,* which Zinin obtained by the action of hydrogen on benzoic aldehyd. As it changes to bitter almond oil on dry distillation, we may suppose it a compound of benzoic aldehyd and an aldehyd two atoms richer in hydrogen, since these two atoms of hydrogen are easily removed by the oxygen of the air.

The oil obtained on decomposing the exhausted alkaline solution with hydrochloric acid is an acid having the formula $C_{14}H_9O_3,HO$, the characters of which are not yet clearly made out. Reviewing the whole of the phenomena, the author says that by the action of hydrogen on benzoic acid we must believe that the greater part of the acid is at first, by the loss of 2 atoms of oxygen, changed into aldehyd, and then, by taking up 2 atoms of hydrogen, becomes the alcohol, while a small portion of the acid takes up 4 atoms of hydrogen directly without any change in the oxygen contained. The next papers are by Oefele, "*On a New Class of Organic Sulphur Compounds,*" which has already been communicated to English chemists, and on "*Diethylsulphan,*" $\left.\begin{matrix}C_4H_5\\C_4H_5\end{matrix}\right\}[S_2\Theta_4]$, or sulphuric acid, in which the two extra-radical oxygen atoms are replaced by two atoms of ethyl. It is a crystalline body soluble in alcohol and water.

We must postpone a notice of other papers in the *Annalen* until next week.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2156. Jacques Fnliraud Pascal Hugouneuq, town of Lodève, Département de l'Herault, France, "An improved method of obtaining indigo from textile materials, either yarns or fabrics, previously dyed by the blue soaking process."—Petition recorded September 2, 1864.

2354. George Printy Wheeler, Abinghall, Gloucestershire and John Fox Gloyn, Manchester, Lancashire, "Improvements in the preparation and application of certain materials for the purpose of cleaning or polishing the surfaces of metals, and also applicable to other purposes."—Petition recorded September 26, 1864.

2522. Edouard Moride, Nantes (Loire Inférieuse), and Boulevart St. Martin, Paris, France, "Improvements in the treatment of sea-wrack grass, for the extraction of the carbon and the salts contained therein."

2526. Richard Archibald Brooman, Fleet Street, London, "Improvements in the manufacture of prussiates of ammonia, and in the application of prussiates of ammonia to dyeing, printing, and photography."—A communication from Arthur Baudesson and Paul Honzean, Rheims, France. —Petitions recorded October 13, 1864.

2552. William Clark, Chancery Lane, Middlesex, "Improvements in the preparation of artificial wax." A communication from Jules Montier, Lambert Dietsenbacher, and Abraham Worms, Boulevart Saint Martin, Paris.—Petition recorded October 15, 1864.

2560. John Cassell, La Belle Sauvage Yard, London, "Improvements in apparatus for the carburation of gas and atmospheric air." A communication from Jean Best, Paris, France.—Petition recorded October 17, 1864.

2581. William Taylor, Shiffnall, Henry Harrison Hollinswood, and George Brown, Hollinswood, aforesaid, all in the county of Salop, "Certain improvements in the manufacture of iron."—Petition recorded October, 19, 1864.

2598. William Littell Tizard, Birmingham, Warwickshire, "Improvements in brewing and distilling, and in apparatus employed therein, parts of which are applicable to the separation of liquids from solids."—Petition recorded October 20, 1864.

2628. Richard Hookbam, Regent's Park, Middlesex, "Improved powder magazines and receptacles for storing or keeping gunpowder or other explosive materials, and improved vessels and vehicles for transporting explosive materials from place to place."

2634. William Clark, Chancery Lane, Middlesex, "Improvements in apparatus for concentrating and distilling sulphuric and other acids, and all solutions in general." A communication from Eugéne Alphonse Cotelle, Boulevart Saint Martin, Paris.—Petitions recorded October 24, 1864.

2639. Richard Archibald Brooman, Fleet Street, London, "Improvements in blast and other furnaces." A communication from Auguste De Bergne, Madrid, Spain.—Petition recorded October 25, 1864.

2650. Bonnet Frederick Brunel, Brussels, Belgium, "Improvements in treating titanic iron sands, and in apparatus employed therein."

2654. Richard Hart and John Fraser Calder, Dundee, Forfarshire, N.B., "Improvements in preparing jute."

2656. Peter Armand Le Comte De Fontaine-Moreau, Rue de la Fidélité, Paris, France, and South Street, Finsbury, London, "An improved composition for uniting iron with wood, and leather with leather, for waterproofing textile fabrics, paper, and cordage, for moulding and for various other purposes." A communication from Henry Lemaistre and Company, Brussels, Belgium.—Petitions recorded October 26, 1864.

Notices to Proceed.

1624. Charles Frielinghaus, King Street, Cheapside, "Improvements in the manufacture of starch and yeast, and the machinery employed therein."—A communication from Ignats Ben, Uerdingen, Prussia.—Petition recorded June 29, 1864.

1638. Frederick Ludewig Hahn Danchell, Red Lion Square, Middlesex, "Certain improvements in apparatus by means of which air, gas, or vapour is to be removed from tubes, pipes, tunnels, pans, retorts, or other vessels."—Petition recorded July 1, 1864.

1663. George Holworthy Palmer, Queen's Crescent, Haverstock Hill, Middlesex, "Improvements in apparatus for heating and evaporating liquids and fluids."

1668. William Lloyd, Dartmouth Street, Westminster, "Improvements in the manufacture of hydro-carbon gas, and in apparatus employed therein."—A communication from William Henderson, Valparaiso, South America.—Petitions recorded July 5, 1864.

1766. Richard Archibald Brooman, Fleet Street, London, "Improvements in the manufacture of fluoride of silicium."—A communication from Cyprien Marie Tessie du Motay and Edouard Karcher, Saarbuck, Rhenish Prussia.—Petition recorded July 14, 1864.

2073. James Allan, Dundee, in the county of Forfar, N.B., "An improved adhesive mixture."—Petition recorded August 22, 1864.

2097. Harold Potter, Manchester, "Improvements in bleaching fibrous substances."—Petition recorded August 25, 1864.

2230. Harold Potter, Manchester, "Improvements in bleaching fibrous substances."—Petition recorded September 13, 1864.

2326. Harold Potter, Manchester, "Improvements in bleaching fibrous substances."—Petition recorded September 22, 1864.

2420. Edward Loysel, Park Place, Middlesex, "Improved apparatus for obtaining extracts from tea, coffee, and other vegetable substances." — Petition recorded October 1, 1864.

CORRESPONDENCE.

Continental Science.

Paris, November 16.

The School of Medicine was opened for the session on the 3rd, in the presence of M. Duruy, the Minister of Public Instruction. M. Tardieu, the dean, delivered what you would call the introductory lecture, which consisted of the usual matter—a *resumé* of the discoveries of the past year, praises and regrets for the dead, compliments for the living who retire from the Faculty, and plenty of good advice to the students. M. Duruy added some of the latter on his own account. He was sorry to hear that the students did not attend their lectures regularly; that was wrong. Moreover, he added, wicked people asserted that some men obtained their Doctor's cap who had never bled a patient, or even put on a bandage; that was very wrong. *Il faut changer tout cela!* He was grieved also sometimes to hear it said that doctors beyond the Rhine were more learned, and doctors on the other side of the Channel more practical, than their Professional brethren in France. "Gentlemen," cried his Excellency, "beat the Germans and the English for me!"

M. Tardieu, in his address, mentioned some facts which do not look well for the Parisian medical student. It seems that 2677 presented themselves for examination last year. Out of the number who passed, only one-third obtained a second class, and only 13 out of 1400 obtained a first-class certificate. That, said M. Tardieu, cannot be the normal state of the Faculty of Paris. Bestir yourselves, young gentlemen! Work; study; an ignorant medical practitioner is a public scourge; an ignorant practitioner is a dishonest man! M. Tardieu is evidently of the same opinion as Calonne, Minister of Finance under Louis XVI. Calonne, it is said, died of a pleurisy and "an ignorant practitioner;" and when he was too far gone to be able to speak, he made signs for a pencil and paper, and wrote to his medical attendant as follows:—"You have murdered me! and if you are an honest man you will never practise medicine any more." I wonder whether Cavour wrote anything like that to his doctors!

Writing on education, I may mention that the scientific journals notice as an event the opening of some evening schools at Mulhouse. They seem to be a combination of your schools of design and an ordinary evening school. Besides reading, writing, common arithmetic, and bookkeeping, instruction is given in German and English and design. The classes are held in different factories after the day's work is over, and it seems that they are exceedingly well attended. A public lending library has also been lately opened in the same city. These things are new here, and much good is expected of them.

I may return to the *soirée* at the Conservatoire mentioned last week, in order to notice some of the objects of interest exhibited. Among these was the apparatus used by Lavoisier in effecting the synthesis of water. This has been presented to the Conservatoire by the Academy of Sciences, who kept it in their cellars out of sight. The present proprietors, however, have had the apparatus cleaned up and made to look as good as new. Is Cavendish's eudiometer still in existence, and where is it to be seen? M. Tresca thinks it a good idea to make a collection of such objects, and I agree with him. The simple apparatus of some of the leading discoverers would look strange beside the magnificent display of apparatus which the public professors have at their disposal—paid for, however, out of the public purse. George Stephenson's "Rocket" is at South Kensington; why should they not have Cavendish's eudiometer, if they can get it, and Davy's battery, if the Royal Institution will part with it? How interesting, too, would be a sight of Wollaston's small and simple stock of apparatus.

As you are likely to be short of food for cattle this winter, I may mention that they are feeding pigs here on rice with great success. Porkers, it seems, gain 25 kilogrammes in weight for every 100 kilogrammes of rice consumed. They are allowed to eat the rice as we are bread at the *restaurants—à discretion*. I did not think the discretion of a pig could be trusted in the matter of food.

The sewage question begins to be agitated here, and there is a loud outcry on the part of the engineers against contaminating the Seine like the Thames. To distribute the sewage over the country is the remedy proposed, as with you; but since Paris has yet to be drained, the country must wait.

Some people here have taken it into their heads that England is in a great hurry to adopt the metrical system of weights and measures. Coupled with this come expressions of lively regret that the majority of French people in the provinces obstinately refuse to adopt these weights and measures, and stick to the local systems, which vary as much as they do in England. But, then, the people are used to them, and they have no wish to go to school again.

I have only one more piece of information, and that is that some spinners at Lille, MM. Mallard and Bonneau, state that China grass is a perfect substitute for cotton, or that the two may be mixed with great advantage. China grass, I believe, is well known in England, but I do not remember whether it has been used in this way. There is some difficulty, it seems, in the carding, but that they expect soon to get over. Equal weights of the grass and Surat cotton are said to make a first-rate yarn. The mixture, or the grass alone, will dye as well as the best American cotton. Some people believe that the grass may be acclimatised and grown in France and Algeria. The Americans had better finish their war.

Mineral Densities.

To the Editor of the Chemical News.

Sir,—My attention has been called to your report of the last meeting of the Chemical Society, in No. 258 of the Chemical News, in which allusion is made to a short paper of mine inserted in the *Proceedings of the Royal Society* (xiii. 64. 240). It appears that Mr. Church in repeating the experiments on garnet, &c., there recorded, has failed to arrive at the results consigned in my note. If the author publishes his observations in the Journal of the Society, I shall reply to them when they have appeared; if not, I shall do so, with your permission, in the Chemical News.

It may be, as Mr. Perkin stated at the meeting, that Mr. Church weighed his specimens before they had completely cooled (unless he adopted my method of taking the densities, when such an error would be impossible), but I think his failure is owing to another cause, which will be referred to hereafter. I am, &c.

T. L. Phipson, Ph.D., &c.

London, November 14.

Substitute for Photographic Yellow Glass.

To the Editor of the Chemical News.

Sir,—I see in the *Popular Science Review* that you recommend gelatine treated with AgO,NO_5 as a substitute, when applied to slender fabrics, for yellow glass in the windows of photographic dark chambers and tents. I venture to suggest, as preferable, gelatine dissolved as usual, and mixed with a hot solution of $KO2CrO_3$; it leaves no pinholes, gives a clear orange tint, is perfectly weatherproof, and is so firm that it admits of the use of a slight fabric which does not itself obstruct the light. The utility of the mixture for this and many other purposes recommended itself to me as a consequence of my use of it when working at photolithography with Mr. Osborne, Wincanton. Mixed with lampblack, it is a capital and lasting pigment. I use it on my blackboard, and it stands any amount of washing after it has been actinised. I jocularly call my blackboard a carbon print. The gelatine and $KO2CrO_3$, either with or without pigments, is also a capital material for coating bottles for substances that require darkness, as the copper solution for sugar-testing, chlorine water, nitrate baths, &c.; the bottle need only be dipped in a moderately strong solution. It will also do in some cases for repairing cracks in glass and porcelain (a matter of some importance here, where replacement is not easy as with you). When the salt is in excess it gives a pretty crystalline moiré appearance, which may have a decorative value, especially when pigments are used. Other uses suggest themselves as occasion requires.—I am, &c. W. Sydney Gibbons.

Melbourne.

MISCELLANEOUS.

Lighting and Ventilation.—It is not our province to criticise the drama, but we may point out, among the many improvements introduced by Mr. Horace Wigan into the Olympic Theatre, the admirable mode of lighting and ventilating it. Gas lights are entirely excluded from the auditorium, and the customary chandelier is replaced by a sunlight in the roof, protected by ground glass. It is the only theatre in London wherein one does not breathe that curious, complicated mixture of carbonic acid and animal effluvia of which the atmosphere of a theatre is usually composed; the only theatre where one escapes that brow-heaviness and lassitude so well known to play-goers.

"Our Inheritance in the Great Pyramid."—We learn that the Astronomer-Royal for Scotland, armed with a firman giving him full powers, is about to visit the Great Pyramid, with a view of investigating the "Metrology" of that remarkable structure, to which he has has recently called attention. Professor Smyth takes out magnesium wire, in order to photograph the interior, especially the mysterious inner chamber and more mysterious coffer.—*The Reader.*

Rapid Reproduction of Pencil Drawings.—Our attention has been called to a rapid method of reproducing pencil drawings, plans, and sketches, mentioned in the *Invalide Russe* as founded upon an observation made some time ago by M. Villani-Villanis. "Si on humecte avec une solution acidulée un papier sur lequel est tracé un plan on de l'écriture au crayon de mine de plomb ordinaire," are his words, "et si on vient à encrer ce papier, il arrive que le trait de crayon prend seul l'encre, et qu'on peut ensuite opérer le transport du dessin sur métal ou sur pierre." Acting upon this hint, Captain Sytenko of the Imperial Artillery, Directeur du Service Photographique de l'Etat Major, found that pencil drawings, after the paper had been moistened with acidulated water and inked as suggested, could readily be transferred to zinc or stone. He has introduced some modifications into the process and invented a portable press, which will be particularly useful in campaigns, where it is often desirable to have a number of copies of a hasty pencil sketch. It does not take more than ten minutes to effect the transfer of the drawing upon a zinc plate or lithographic stone.—*The Reader.*

ANSWERS TO CORRESPONDENTS.

_ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

_ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

Vol. IX. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. X. commenced on July 2, 1864, and will be complete in 26 numbers.

J. C. N.—No report so full as our own has been published.

C. Eaves.—You might perhaps get it from Messrs. Bell and Co., Newcastle.

Dr. Adriani.—The letter is much too long for insertion, and is, moreover, almost undecipherable. It lies at our office.

Chemicus.—The filtration suggested is practical on a large scale, but it would probably be too effective for your purpose. The distillation after digestion we know from experience would not answer.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

The Passivity of Metals, by M. W. Heldt.

The author has made numerous experiments on the so-called *passive* state of metals—that is to say, that particular state in which the nature of the metal seems to undergo a permanent change by the action of certain agents, and has come to the conclusion that no such state really exists. The phenomena, he states, (1) are all produced simply at the surface of certain metals, those whose nitrates are insoluble in nitric acid, and the passivity belongs to this insoluble layer, and not to a particular electro-dynamic state or to a polarisation. It is only those metals whose nitrates are soluble in diluted nitric acid and insoluble in concentrated acid which present these phenomena.

With copper and tin the insoluble layer is visible to the naked eye; with others it can be seen with a lens. The acidulated water easily removes it, and the metal returns to its normal condition; the lixivium contains nitric acid, the presence of which is easily recognised, and also metallic oxide. With tin it is necessary to scratch or file the surface, because the oxide is insoluble.

His other conclusions are as follow:—

2. Contact of the metal with platinum, in concentrated nitric acid, which, moreover, will attack the metal to a certain point, quickly determines the precipitation of an anhydrous nitrate, and puts an end to all action; the disengagement of gas ceases with the contact of the platinum. With tin the white film of insoluble oxide directly appears, even with diluted acid. With the other metals platinum effects nothing in the diluted acid, because it dissolves the nitrate formed. The contact of the metal with platinum accelerates oxidation, for the insoluble anhydrous salt spreads over all the submerged surface, as if it had been melted and poured over it; and as all these salts are transparent and brilliant, the metal shines through them as if it had not been attacked. This is especially the case with copper.

3. The rust of iron acts in the same way as platinum in concentrated nitric acid, in contact with iron. But in diluted acid it merely prevents the disengagement of gas, and the metal dissolves in the state of nitrate of protoxide, with which the binoxide of nitrogen forms blackish tints in the liquid. The liquid contains ammonia.

4. The mass of metal has a marked influence on the decomposition of the acid. When in a very divided state, as filings or fine shavings, it will decompose an acid on which, in its compact state, it would exert no effect.

5. In nitrate of lead, silver, and protoxide of mercury, iron acquires none of this so-called passiveness, the metal, when washed, having all the properties of metallic iron.

6. Rust of iron, in contact with iron, precipitates the copper of its sulphate, while without contact of the iron no effect results. It is the same with iron oxidised by calcination at red heat. But iron steeped in concentrated nitric acid, and covered with a film of insoluble nitrate, does not act on the solution of sulphate of copper—not, at least, unless washed or touched in the liquid, with some readily oxidisable metal.

7. Similar results may also be obtained by adding to the nitric acid a liquid in which the nitrate formed will be insoluble or nearly so. Thus zinc is but very slightly attacked in nitric acid, to which absolute alcohol has been added, and mercury is not attacked at all.

8. Lowering the temperature produces the same results by diminishing the solubility of the salts. At 20°, zinc in monohydrated acid becomes covered with a white layer; but on removing the cooling mixture, this layer of nitrate dissolves, and the reaction becomes very violent. Acid with four equivalents of water, which violently attacks zinc at 0°, leaves it with all its brilliancy at 18°.

9. When nitric acid is concentrated to the point at which it either does not attack a metal or attacks it very slightly, the addition of a little nitrous acid or binoxide of nitrogen determines the reaction, because these two compounds give up their oxygen more easily; but if the binoxide of nitrogen is absorbed by the addition of sulphate of iron, all action ceases.

10. An iron wire rendered inactive by the coating of anhydrous nitrate touched with a metal, such as copper, zinc, or iron itself, either in the liquid or after withdrawing it, the disengagement of gas recommences, and the chemical action is renewed; this is simply because at the points of contact the unattackable coating has been disturbed; the acid being again in contact with the metal, the oxide of nitrogen which is formed glides between the metal and the coating, and detaches it (?).

11. With nitric acid, carbonates behave in the same way as metals. Fused carbonates of soda and lead are not attacked by concentrated nitric acid; carbonate of baryta may even be placed in contact with boiling concentrated nitric acid without undergoing decomposition. Nitrates of soda, baryta, and lead are insoluble, or nearly so, in concentrated nitric acid; but saltpetre dissolving in it, concentrated nitric acid attacks carbonate of potash—at least, on the addition of alcohol.

12. In contact beneath the acid, with bismuth, tin, iron, or copper, platinum forms with them the element of a pile, of which it is the negative pole. The tin immediately becomes covered with a kind of enamel of white oxide, without any apparent disengagement of gas; with iron, bismuth, and copper, the deposit is like glass—a transparent, brilliant nitrate of peroxide. This current occasions the highest degree of oxidation. In diluted acid, the contact of the platinum has no effect, because the current is not strong enough to condense on the metal sufficient acid to form this salt of peroxide, and prevent the disengagement of gas, which prevents the unattackable coating from adhering to the surface.—*Les Mondes.*

PHARMACY, TOXICOLOGY, &c.

Action of Iodine, Bromine, and Chlorine upon Sugar, by E. Fougera.

I do not know of any work upon chemistry, or of any chemist, having described the action of iodine upon sugar; yet the changes which take place between these two bodies deserve being studied by scientific men.

I have only to report a series of facts, the result of my experiments since 1856, in the preparation of the syrup of the iodide of iron, which led me to study the action of iodine, bromine, &c., upon sugar.

I have observed the two following facts:—

1. The partial spontaneous decomposition of the syrup of iodide of iron by exposure to the air is arrested at a certain point, and does not go farther, even if exposed for several months in a capsule only covered with paper.

2. This syrup, lightly decomposed, or even coloured by the addition of a small quantity of iodine, becomes perfectly white after a long exposure to the sun's rays

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or to a moderate heat; replaced in the dark, it resumes its amber colour.

However, two phials hermetically sealed, each containing the syrup of iodide of iron, one coloured by natural decomposition, the other by the addition of a small quantity of iodine, were exposed for a year to the sun's rays, then both the syrups were colourless; and they remained so for more than a year, though they were left in a dark cellar, and in half-filled bottles.

The first fact reverses the old theory of the decomposition of the syrup of iodide of iron, which was explained by the formation of a protoxide of iron and iodohydric acid, by means of the decomposition of the water into its two elements, and by the transformation of the protoxide of iron into sesquioxide of iron by the oxygen of the air. Evidently, should the decomposition of the water and of the iodide of iron operate thus, this process should continue to that point when all the iodide of iron is decomposed; this does not take place.

To explain the second fact I asked myself what became of the free iodine? for surely it could not combine itself with the proto-iodide of iron to form a sesqui-iodide; the sesqui-iodide of iron being red, should have remained so; we know, upon the other hand, that water dissolves hardly more than $\frac{1}{1000}$th of iodine, which, according to some chemists, is transformed into iodic and hydriodic acids. The last question was, then, to know how free iodine acted upon sugar.

To elucidate this question, I made various experiments with iodine and simple syrup. I soon found that, with a moderate and prolonged heat, this metalloid added to the syrup was subject to a great chemical change.

One to ten grains of iodine, added to one ounce of simple syrup, in a strong bottle closed with a glass stopper, the whole exposed in a water bath at a moderate heat (60° C.), are dissolved little by little, and give the liquid a reddish brown colour; but after several hours, the whole being always kept at the same temperature, the syrup again becomes discoloured. The flask must be cautiously shaken from time to time. The whole operation occupies about forty-eight hours.

In operating with a syrup containing half a drachm of iodine to the ounce, I obtained, with some trouble, however, a similar colourless product.

The greater the proportion of iodine, the more attention is required; and towards the end of the operation, care must be taken to remove the syrup as soon as it turns white.

Arrived at this point, if the preparation is left exposed to heat, it soon colours again; by-and-by the sugar is transformed into caramel; and this burned sugar, quickly destroyed in its turn, gives rise to carbonic acid and to a blackish, light, and spongy substance, partly soluble in water and alcohol. Treated by hydrochloric acid, potash, &c., this substance shows the same reactions as ulmin and ulmic acid. To carry on this operation to the entire decomposition of the sugar, all necessary care must be taken to prevent a fracture of the flask by the expansion of carbonic acid gas, which is formed in quantities, and can be collected.

The more the temperature is elevated, the larger is the proportion of iodine, and quicker is the sugar decomposed.

This white syrup of iodine, or iodinised syrup, has sometimes an aroma of fruit; it is acid, unalterable by air, heat at 100° C. decomposes it; it contains much glucose. Treated with the reagents, it behaves like iodides in general.

These are the facts; the theory remains to be given.

Does the iodine, all or in part, combine with the sugar $C_{12}H_{11}O_{11}I$, or to the glucose $C_{12}H_{14}O_{14}I$, to form iodides similar to the iodide of starch, $C_{12}H_{10}O_{10}I$?

Or rather, in presence of sugar acting as a catalytic agent, should not iodine decompose the water into its elements, hydrogen and oxygen, and unite with them to form hydriodic and iodic acids? If so, these acids, once formed, would decompose the sugar precisely in the same way as the mineral and some other acids.

If not so, what are these acids, and how are they formed? Is it from the decomposition of the sugar or of the water?

Bromine acts upon sugar in the same manner as iodine, with the difference that the diverse phenomena follow more rapidly.

Chlorine acts upon simple syrup still more promptly than bromine; into water freshly saturated with chlorine, at a very cold temperature, I have thrown sugar, and heated the liquor as I have described for iodine. In less than half an hour the chlorine had disappeared, and the liquor was acid.

Chlorine was probably transformed into hydrochloric acid.—*American Journal of Pharmacy.*

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.

Thursday, November 17.

General SABINE, *President, in the Chair.*

A PAPER, by Mr. Huggins, "*On the Spectra of some of the Nebulæ*" was read. The paper was a continuation of that on the spectra of the fixed stars by Mr. Huggins and Professor W. A. Miller. The former paper showed the similarity of essential constitution which exists among the stars, and between them and our sun. The present examination was undertaken to ascertain whether the same similarity extended to the nebulæ. Prismatic analysis seemed to be a method of observation specially suitable for determining whether any essential physical distinction separates the nebulæ from the stars, either in the nature of the matter of which they are composed, or in the conditions under which they exist as sources of light. For increase of optical power alone fails to give the desired information, since the researches of Lord Rosse have shown at the same time that the number of clusters may be increased by the resolution of supposed nebulæ, other nebulous objects are revealed, and fantastic wisps and diffused patches of light are seen which it would be assumption to regard as due in all cases to the united glare of suns still more remote. The nebulæ selected for examination were those which present small round or oval discs, and therefore classed by Sir John Herschel as planetary nebulæ. They present but little indication of resolvability, have a green and sometimes bluish colour, and show no sign of central condensation. The first examined was a nebula in Draco 37. H. iv. The light of this nebula, unlike that of any other ex-terrestrial body examined by the author, was not composed of light of different refrangibilities, and therefore could not form a spectrum. A greater part is monochromatic, and, after passing through the prisms, remains concentrated in a bright line, occupying in the instrument the position of that part of the spectrum to which its light corresponds in refrangibility. A more careful examination with a narrower slit showed that a little more refrangible than the bright line, and separated from it by a dark interval, a narrower and much fainter line occurs. Beyond this, again, at about three times the distance of the second line, a third exceedingly faint line was seen. The position of these lines in the spectrum were determined by a simultaneous comparison of these with the spectrum of the induction spark taken from electrodes of magnesium. The strongest line corresponds in position with the brightest of the air lines; this line is due to nitrogen, and occurs in the spectrum about midway between b and F of the solar spectrum. The faintest of the lines of the nebula agree in position with the line of hydrogen corresponding to Fraunhofer's F. The other bright line was compared with the strong line of barium 2075; this line is a little more refrangible than that belonging to the nebula. Besides these lines, an exceedingly faint spectrum was just perceived for a short distance on both sides of the group of bright lines. The author suspects that this is not uniform, but crossed with dark spaces; subsequent observations on other nebulæ induced him to regard this faint spectrum as due to the solid or liquid matter of the nucleus, and as quite distinct from the bright lines into which nearly the whole of the light from the nebula is concentrated. The colour of this nebula is greenish blue. In most of the other nebulæ examined the three bright lines were seen in the same positions, and in some a fourth line was observed. With regard to the nebula the spectrum of which we have just described, and some others, the author observes that they can no longer be regarded as aggregations of suns after the order to which our own sun and the fixed stars belong, but objects possessing a distinct and peculiar plan of structure. In place of an incandescent solid or liquid body transmitting light of all refrangibilities through an atmosphere which intercepts by absorption a certain number of them, such as our own sun appears to be, we must probably regard these bodies, or at least their photo-surfaces, as enormous masses of luminous gas or vapour; for it is alone from matter in the gaseous state that light consisting of definite refrangibilities only, as is the case with the light of these nebulæ, is known to be emitted. It is, indeed, possible that suns endowed with these peculiar conditions of luminosity may exist, and that these bodies are clusters of such suns; but there are considerations which are scarcely in accordance with the opinion that they are clusters of stars. One of these is found in the extreme simplicity of constitution suggested by the three bright lines, whether or not these are regarded as indicating the presence of nitrogen, hydrogen, and a substance unknown. With the exception of nitrogen, the author states that not one of the thirty elements, the spectra of which he has measured, has a strong line very near the bright line of the nebulæ. If, however, this line were due to nitrogen, other lines should be seen; for there are specially two strong double lines in the spectrum of nitrogen, one at least of which, if it existed in the light of the nebulæ, would be easily seen. In the author's experiments on the spectrum of nitrogen, he observed that the character of the brightest of the lines, that with which the line in the nebulæ coincides, differs from that of the two double lines next in brilliancy. It is more nebulous at the edges, even when the other lines are thin and sharp. The same phenomenon was observed with other elements. May not this difference of character observable in the lines of the same element indicate a physical difference in the atoms in connection with the vibrations of which they are probably produced? The speculation presents itself whether the occurrence of this one line only in the nebulæ may not indicate a form of matter more elementary than nitrogen, and which our analysis has not yet enabled us to detect.

The next paper was by Forchammer, on the composition of sea water at different depths, a report of which we are compelled to defer.

Simpson v. Holltday.—This case is now before the Lord Chancellor on an application by the defendant for a new trial, or the reversal of the decision of Vice-Chancellor Stuart. Our readers are by this time well acquainted with the matters in dispute, and we shall not further allude to the case until the decision of the Chancellor is given.

CHEMICAL SOCIETY.

Thursday, November 17.

Professor A. W. Williamson, Ph.D., F.R.S., *President, in the Chair.*

The minutes of the previous meeting having been read and confirmed, and the donations to the library acknowledged, the names of thirteen candidates for admission into the Society were read over for the second time, and Mr. Alexander Stuart, Apothecaries' Hall, London, was proposed for the first time.

We subjoin a complete list of the names which will be balloted for at the next meeting of the Society (December 1):—Clayton S. Beauchamp, Lieutenant Royal Engineers; Mr. John Bray, High Street, Mild Town, Sheerness; Mr. Charles Eken, Bath; Mr. Henry Haywood, Broomhall Park, Sheffield; Henry Montague Hozier, Lieutenant 2nd Life Guards, Topographical Department, New Street, Spring Gardens; Mr. Daniel Harmer Jay, Manufacturing and Analytical Chemist, Frog Island, Leicester; Mr. Joseph F. Payne, M.A., Magdalen College, Oxford; Mr. J. G. F. Richardson, Manufacturing Chemist, Leicester; Mr. William White Rouch, Norfolk Street, Strand; Lieut.-Colonel H. Y. D. Scott, Royal Engineers, Eeling, and South Kensington Museum; Mr. J. Berger Spence, Pendleton Alum Works, Newton Heath, Manchester; Hermaun Sprengel, Ph.D., Chemical Works, Kennington Common; and Mr. Alfred Phythian Tamar, 3, Upper Baker Street, London.

A resolution of the Council, referring to the proposed removal from the list of Fellows some few members who have allowed their subscriptions to lapse for more than three years, was read a second time, and will likewise be decided by ballot at the next meeting.

The President then invited Dr. Marcet to favour the Society with his promised communication "*On the Brine of Salted Meat.*" The author commenced by pronouncing a graceful eulogium upon Professor Grahom's researches on Liquid Diffusion or Dialysis. Very shortly after these results were made known Dr. Marcet conceived that the principle might be turned to account advantageously in connexion with the curing of meat, and two years ago he instituted experiments upon the treatment of meat brines with the view of removing the salt by dialysis. He evaporated the salt brine at a moderate temperature to one-third its original bulk, decanted from the crystals of common salt which had separated, and placed the liquid in a dialyser for the purpose of removing the rest of the salt. He obtained in this manner, in periods varying from eighteen to thirty-six hours, a palatable beverage, which had only to be warmed in order to furnish a good and cheap soup. So important did these results appear, that Dr. Marcet wrote at once to a friend in Liverpool advising him to make a trial of the plan for the benefit of the distressed Lancashire operatives; the author did not, however, entertain any intention of publishing his experience until he had found opportunities of further pursuing the matter, for although the liquid had the smell and taste of broth he could not then say whether there was a deficiency of nutritive ingredients, and later he found that much of the phosphates and lactates, kreatin and kreatinin were lost. In the meantime, however, a short account of his experiments appeared in the *Family Herald*, without his knowledge or sanction, early in the year 1863. Since then he had resumed the subject for the purpose of turning a waste commodity, if possible, to some practical account, and he considered that meat brine was admirably adapted to the preparation of kreatin and kreatinin, and could be used as a source of lactic acid. The process employed in the recovery of these constituents was first to boil the brine in order to coagulate the albumen; this being strained off the liquor was evaporated until much of the salt had crystallised out, alcohol was then added, and to the clear fluid a small quantity of a highly concentrated solution of chloride of zinc; then set aside in order to permit of the gradual deposition of crystals of lactate of zinc, but inasmuch as some of the lactic acid and all the kreatin, &c., remained in solution, he treated the mother liquor with oxide of lead, which effected a complete separation of the acid from the neutral substances. The lactate of lead was transformed into the characteristic lime salt (exhibited) by boiling the precipitate with sulphuric acid and then neutralising with chalk. The kreatin and kreatinin were recovered by evaporating the solution to dryness and treating with alcohol, in which the latter is very soluble, the kreatin was afterwards taken up by water and crystallised from aqueous solution. In the course of these researches the author observed an anomaly in the fact that very large quantities of albumen were dissolved out from muscular tissue by the action of water; he started with the supposition that flesh was a colloid, and, as such, would not permit of the outward diffusion of albumen. This experimental result stood apparently in opposition to the laws of liquid diffusion, but there was a difference in the character of albumen, that contained in blood requiring a higher temperature to coagulate it than the albumen of flesh. In order to make this point more clear, Dr. Marcet showed at the meeting the comparative results of two experiments; one was a piece of beef merely immersed in water to which it had already in the course of the day imparted a red colour and some soluble albumen, whilst in a second glass some juice of flesh inclosed securely within a pig's bladder showed no signs of albumen after twelve hours. The structure of a piece of muscular tissue cannot then bear any comparison with an ordinary colloidal septum, as was at first supposed. Further, if a piece of flesh be immersed in liquid gelatine and the whole allowed to set, no albumen passed out until the sixth or seventh day, when a red zone appeared in the jelly around the meat and faintly coloured the isinglass. The author next made experiments of a similar kind, but with very delicate animal membranes, such as that which covers the liver in the ox and sheep. This membrane, thin as gold-beater's skin, was made into dialysers, which being charged with juice of flesh allowed variable quantities of albumen to pass during the first day. The structure of flesh must, therefore, be defined as consisting of an infinite number of delicate membranes through which the liquids may constantly circulate by capillary motion. Dr. Marcet next addressed himself to the following inquiry?—Are the various soluble constituents of meat equally diffusible? and, particularly, whether is albumen or phosphoric acid more readily transmitted through animal membranes? For a truly comparative experiment the author made quantitative analyses of the aqueous extract of beef, and of the aqueous diffusate from a precisely similar quantity of beef. Two hundred grammes of meat were treated in each case with 125 cubic centimetres of distilled water, and it was found that, in the case of the extract, the phosphoric acid was in proportion to the albumen as 1 : 12·5, whilst the liquid diffusate, after twenty-six hours, contained the same constituents in the ratio of 1 : 6·3; thus it was proved that the albumen was only half as diffusible as the phosphoric acid. In another experiment, which lasted four days and confirmed the former result, the ratios of phosphoric acid to albumen were respectively 1 : 9·5 in the extract, and 1 : 4·4 in the aqueous diffusate. The speed at which albumen will pass through an animal membrane is, however, mainly regulated by the degree of acidity or alkalinity of the fluid, and the author found that when the liquid was decidedly alkaline, a mere trace only of albumen was allowed to pass. The same observation was equally applicable to the dialytic analysis of urine, and was particularly noticed when baryta water had been employed in slight excess for the purpose of precipitating the phosphates and sulphates. Reverting to the practical part of the question, Dr. Marcet pointed out the fact that not only was there a loss of nutritive constituents during the process of salting, but when subsequently it was desired to cook the meat it was usually immersed for some time in pure water to remove the great excess of salt. Here, likewise, there was a waste of valuable constituents which could by a modification in the treatment be avoided. The author proposed to cut the meat into small pieces, add from 10 to 20 per cent. of common salt, and fill into sausage skins or bladders. The whole should then be immersed in a concentrated brine until the meat was deemed to have been sufficiently impregnated throughout. At the end of a month, during the hottest season of last year, the meat was found upon trial to have a better flavour and to be more tender than that cured in the usual way. If desired, much of the salt could be removed from the sausage meat by soaking the skins in fresh water; and the author, in conclusion, recommended that whenever it was necessary to remove the excess of salt from meat, cured either on this principle or in the ordinary manner, the joint should be securely wrapped in a bladder before being introduced into water, and thus a considerable proportion of the nutritive matters be retained.

The PRESIDENT felt greatly interested in the subject of Dr. Marcet's investigation. It was well known that waste occurred; the question to be settled was how this could best be avoided. He wished to ask the lecturer whether in the experiment before them be relied upon the red colour of the liquid as being the sole indication of the presence of albumen?

Dr. MARCET replied that he always found the red colouring matter accompanying the albumen; there was no philosophical reason for this being the case, but chemical tests invariably proved it. The red blood-corpuscles were, of course, destroyed, and their coloured contents became mixed with the albumen.

Professor GRAHAM considered that the lecturer had treated of muscular mass too much in the light of a homogeneous substance; it would be better to distinguish between the fibrous and fluid ingredients somewhat as water in a sponge, and if then by mechanical forces the meat suffered contraction, as when immersed in salt, the fluids were ejected as a necessary consequence, and not so much by virtue of a dialytic action, as had just now been represented. If threads of fibrin were soaked first in acetic acid, and then removed into salt-brine, they would be found to contract very considerably. With regard to the dialytic transfer of albumen, the speaker thought it desirable to make further experiments before this could be confidently asserted; it was necessary to bear in mind the difficulty of procuring absolutely perfect dialysers, animal membranes were never water-tight, and even thick bladders had sensible apertures through which albumen itself could flow out, especially under the pressure of a few inches of water. It was always necessary to take the precaution of testing the dialysers before their employment.

Dr. MARCET could not allow that the structure of muscular tissue bore any comparison with water in a sponge, for he had never succeeded in expressing any liquid from a piece of meat, even under a hydraulic press; it was impossible to get evidence upon a dry sheet of filter paper of the expulsion of more than traces of fluid or moisture; then it must be remembered that he had employed pure water, not brine, in the experiments by which albumen had been extracted; meat always contracts and becomes hardened under the influence of salt. With respect to the preparation of the animal membranes, he had torn them from the sheep's liver in preference to removing them by the aid of a dissecting knife, so as purposely to shut out this source of error.

Dr. A. W. HOFMANN referred briefly to the new plan proposed by Dr. Morgan, of Dublin, for salting animals whole. Immediately after slaughtering, a communication was established between the principal arteries and a reservoir of salt brine placed at a high-level, the effect of which ensured the diffusion of salt through the meat by a process of injection. The published statements affirmed that for the cost of sixpence halfpenny, and in the course of ten minutes, a whole ox could be preserved.

Dr. **Paul** made a further statement on the same subject, and said that the quantity of salt might now be so much diminished that it became unnecessary to wash the meat preparatory to cooking.

Dr. **Crace Calvert** warmly advised the undertaking of chemico-physiological experiments in connection with the intestinal absorption of food.

A paper was read by Professor **Wanklyn** "*On the Nature of Compound Ethers*," an abstract of which shall appear in our next number.

The meeting was then adjourned until December 1.

LECTURES ON CHEMICAL PHILOSOPHY.—VII.

Delivered at the College of France, by M. A. Wurtz.

Condensed Types.

We have seen the advantages of the theory of types in two respects—in the clearness with which it enables us to interpret the metamorphoses of bodies, and in the relationship it establishes between mineral and organic compounds. Let us now pursue the subject further and apply the theory to a higher order of compounds. We shall treat to-day of *condensed types*, and follow the relations which the typical notation establishes between certain groups of mineral and organic compounds, and endeavour further to account for the part which polyatomic radicals play in the generation of complex compounds.

We have already explained the real meaning of the typical formula of acetic acid

$$\left.\begin{matrix}C_2H_3O\\H\end{matrix}\right\}O$$

which expresses at once the principal facts of the history of this acid. Let us now consider succinic acid:—We bring this acid under the type of water twice condensed $\left.\begin{matrix}H_2\\H_2\end{matrix}\right\}O_2$, and write its formula $\left.\begin{matrix}C_4H_4O_2\\H_2\end{matrix}\right\}O_2$.

This formula explains that succinic acid is derived from

$$\left.\begin{matrix}H_2\\H_2\end{matrix}\right\}O_2$$

by the substitution of $C_4H_4O_2$ for H_2; in other words, that it is diatomic.

The following equation,—

$$\underbrace{C_4H_4O_2Cl_2}_{\text{Chloride of succinyle.}}+\left.\begin{matrix}H_2\\H_2\end{matrix}\right\}O_2=2HCl+\underbrace{\left.\begin{matrix}(C_4H_4O_2)''\\H_2\end{matrix}\right\}O_2}_{\text{Succinic acid.}}$$

indicates, in fact, that the formation of the acid is effected by a double substitution which implies the equivalence of $C_4H_4O_2$ to H_2 and to Cl_2; that is to say, implies the diatomicity of succinyle, and consequently of the acid.

The typical formula suggests that succinic acid can form two kinds of salts and two kinds of ethers according as we replace one or two atoms of the typical or extra-radical hydrogen by one or two metallic atoms, or one or two molecules of alcoholic radicals; that the acid can form two chlorides according as we replace one or two of the groups HO by chlorine,

$$\underbrace{C_4H_4O_2,Cl_2}_{\text{Chloride of succinyle.}}\ \text{and}\ \underbrace{\begin{matrix}\left.\begin{matrix}C_4H_4O_2\\H\end{matrix}\right\}O\\Cl\end{matrix}}_{\text{Chlorosuccinic acid.}}$$

and lastly two amides

$$\underbrace{(C_2H_4O_2)''H_1N}_{\text{Disuccinamide.}}\ \text{and}\ \underbrace{\left(\left.\begin{matrix}C_4H_4O_2\\H\end{matrix}\right\}O\right)'H_2N}_{\text{Succinamic acid.}}$$

according as we replace one or two of the groups HO by NH_2. Thus these typical formulæ express very clearly the manner in which all these bodies are derived from succinic acid, and the bonds which unite them to it. We may remark further that the notation allows us to foresee the existence of a chloro-succinic acid, a sort of succinic chlorhydrine which has not yet been prepared.

The formulæ by which we represent the polyatomic alcohols give us the same kind of information. We represent glycol by

$$\left.\begin{matrix}(C_2H_4)''\\H_2\end{matrix}\right\}O_2\ \text{derived from the type}\ \left.\begin{matrix}H_2\\H_2\end{matrix}\right\}O_2$$

and we represent glycerine by

$$\left.\begin{matrix}(C_3H_5)'''\\H_3\end{matrix}\right\}O_3\ \text{or belonging to the type}\ \left.\begin{matrix}H_3\\H_3\end{matrix}\right\}O_3.$$

The formula of glycol

$$\left.\begin{matrix}(C_2H_4)''\\H_2\end{matrix}\right\}O_2$$

indicates to us that in this compound one or two atoms of hydrogen are replaceable by one or two atoms of acid radicals; that one or two groups HO* may be replaced by Cl, Br, or NH_2. The formula of glycerine

$$\left.\begin{matrix}(C_3H_5)'''\\H_3\end{matrix}\right\}O_3$$

teaches us that in this compound one, two, or three atoms of hydrogen, and one, two, or three molecules HO may be exchanged for new elements or new groups to form a multitude of compounds, the existence of which we can thus foresee, and the conditions of whose formation we can determine.

Glycol, for example, in this way gives rise to two chlorides—

$$\underbrace{\begin{matrix}\left.\begin{matrix}(C_2H_4)''\\H\end{matrix}\right\}O\\Cl\end{matrix}}_{\text{Monochlorhydric glycol.}}\quad\text{and}\quad\underbrace{(C_2H_4)''Cl_2}_{\text{Chloride of ethylene.}}$$

Glycerine in the same way gives three chlorides—

$$\underbrace{\begin{matrix}\left.\begin{matrix}(C_3H_5)'''\\H_2\end{matrix}\right\}O_2\\Cl\end{matrix}}_{\text{Monochlorhydrine.}}\qquad\underbrace{\begin{matrix}\left.\begin{matrix}(C_3H_5)'''\\H\end{matrix}\right\}O\\Cl_2\end{matrix}}_{\text{Dichlorhydrine.}}\qquad\underbrace{(C_3H_5)'''Cl_3}_{\text{Terchlorhydrine.}}$$

Let us now see whether any compounds exist in mineral chemistry which we can compare with the foregoing—that is to say, which we can bring under the type of condensed water. Let us compare succinic with sulphuric acid. The former we have said is formed by the reaction of chloride of succinyle upon water. Well, it is the same with sulphuric acid. When chloride of sulphuryle reacts upon water sulphuric acid is formed:

$$\underbrace{SO_2Cl_2}_{\text{Chloride of sulphuryle.}}+\left.\begin{matrix}H_2\\H_2\end{matrix}\right\}O_2=\underbrace{\left.\begin{matrix}(SO_2)''\\H_2\end{matrix}\right\}O_2}_{\text{Sulphuric acid.}}+2HCl$$

The diatomic radical $(SO_2)''$ exists; it is ordinary sulphurous gas. It combines directly with chlorine to form chloride of sulphuryle (Regnault's chlorosulphuric acid). This chloride results from the substitution of Cl_2 for $2(HO)$ in a molecule of sulphuric acid. By treating sulphuric acid with perchloride of phosphorus Williamson obtained the true chlorosulphuric acid

$$\begin{matrix}\left.\begin{matrix}SO_2\\H\end{matrix}\right\}O\\Cl\end{matrix}$$

which results from the substitution of Cl for HO in sulphuric acid.

Thus, sulphuric acid forms two chlorides; it forms also two kinds of salts and two kinds of ethers. The formula

$$\left.\begin{matrix}(SO_2)''\\H_2\end{matrix}\right\}O_2$$

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* To exhibit this mode of replacement more clearly, we might write the formula of glycol $(C_2H_4)''2(HO)'$, and that of glycerine $(C_3H_5)'''3(HO)'$.

shows us all that at a glance; it clearly expresses all the principal properties of this acid, which you now see we are justified in comparing with succinic acid, and regarding as a bibasic and diatomic mineral acid.

We have already compared the alcohols of organic chemistry to the hydrates of mineral chemistry. Thus, to hydrate of lime—

$$\left.\begin{matrix}Ca''\\H_2\end{matrix}\right\}O_2,\ \text{derived from the type}\ \left.\begin{matrix}H_2\\H_2\end{matrix}\right\}O_2,$$

we have compared glycol—

$$\left.\begin{matrix}(C_2H_4)''\\H_2\end{matrix}\right\}O_2.$$

This comparison is formed on a perfect similarity of metamorphoses. Hydrate of calcium is formed by adding water to lime. Glycol is produced in just the same way by placing oxide of ethylene in contact with water.

$$Ca''O+H_2O=\underbrace{\left.\begin{matrix}Ca''\\H_2\end{matrix}\right\}O_2.}_{\text{Hydrate of calcium.}}$$

$$\underbrace{(C_2H_4)''O}_{\text{Oxide of ethylene.}}+H_2O=\underbrace{\left.\begin{matrix}(C_2H_4)''\\H_2\end{matrix}\right\}O_2.}_{\text{Hydrate of ethylene (glycol).}}$$

In the same way we are justified in comparing hydrate of ethylene to the hydrates of some other diatomic metals. The typical formula of glycol indicates to us that this body may form two kinds of salts, just as the formula of the hydrate

$$\left.\begin{matrix}Cu''\\H_2\end{matrix}\right\}O_2$$

teaches us that two kinds of cupric salts can exist. Thus, by combining with acetic acid, glycol gives rise to the two following compounds:—

$$\left.\begin{matrix}(C_2H_4)''\\(C_2H_3O)H\end{matrix}\right\}O_2\qquad\left.\begin{matrix}(C_2H_4)''\\(C_2H_3O)_2\end{matrix}\right\}O_2.$$

In the same way cupric hydrate forms with acetic acid the two following acetates:—

$$\underbrace{\left.\begin{matrix}Cu''\\(C_2H_3O)H\end{matrix}\right\}O_2}_{\text{Bibasic acetate of copper.}}\qquad\underbrace{\left.\begin{matrix}Cu''\\(C_2H_3O)_2\end{matrix}\right\}O_2}_{\text{Neutral acetate of copper.}}$$

We thus compare the ethers of glycol to the cupric salts, and the typical notation shows that this analogy is founded upon the similarity of reactions.

Just as on adding hydrate of potassium to cupric acetate we form acetate of potassium and cupric hydrate, so on adding hydrate of potassium to acetate of ethylene, we form acetate of potassium and ethylenic hydrate or glycol.

Again, with glycol we can form ethers with two acid radicals such as—

$$\underbrace{\left.\begin{matrix}(C_2H_4)'\\(C_2H_3O)'\\(C_4H_7O)'\end{matrix}\right\}O_2}_{\text{Aceto-butyric glycol.}}$$

In mineral chemistry we have salts with two radicals exactly similar, aceto-nitrates, for example, such as—

$$\underbrace{\left.\begin{matrix}Sr''\\(C_2H_3O)'\\(NO_2)'\end{matrix}\right\}O_2}_{\text{Aceto-nitrate of strontium.}}\qquad\underbrace{\left.\begin{matrix}Ba''\\(C_2H_3O'\\(NO_2)'\end{matrix}\right\}O_2}_{\text{Aceto-nitrate of barium.}}$$

(To be continued.)

ACADEMY OF SCIENCES.

November 14.

The first memoir read was by Dr. Hofmann, and entitled "*Further Contributions to the History of the Colouring Matters derived from Coal Tar: Phenyltolylamine.*" The paper has already been communicated to the Royal Society, and was published in the last number of the *Proceedings*, from which we may make an abstract.

M. Pisani presented a note "*On a new Cornish Mineral*" which he has named *Devilline.* In reference to this paper we must call the attention of our readers to a note by Mr. Maskelyne in our "Correspondence." According to M. Pisani, Devilline has the composition—

$$(Cu\dot{Ca}Fe)_3\ddot{S}+3Aq.$$

M. Oppenheim made a communication "*On the Heat of Combustion of Formic Acid.*" Berthelot, from his synthetical experiments, regards formic acid as carbonic oxide *plus* water, but he has been puzzled by the observation that its combustion disengaged more heat than that of carbonic oxide, the water in the acid furnishing none. He concluded that in its formation some absorption of heat takes place, which is to M. Berthelot inexplicable. M. Oppenheim thinks that the typical formula of formic acid

$$\left.\begin{matrix}CHO\\H\end{matrix}\right\}O$$

explains it. The formula shows that formic acid is not a simple compound of carbonic oxide and water, but a combination of the radical formyle with peroxide of hydrogen. Thus in its formation water is decomposed into H and HO, the H first uniting with carbonic oxide to form formyle, which then combines with HO. This decomposition of water the author considers occasions the absorption of heat. In like manner, when the formic acid is produced according to Kolbe's method by the action of carbonic anhydride and potassium on the vapour of water, carbonic anhydride splits up into CO and O, in which case, also, absorption of heat takes place, and thus the heat of combustion of formic acid is equal to that of the combustion of carbonic oxide *plus* the heat absorbed in its formation, and the absorption is explained by the decomposition of the water or carbonic acid. The author further expresses an opinion that the facts mentioned show the influence which the *position* an atom occupies in a compound has upon its physical properties, and believes that the theory of types, originally intended merely to indicate the reactions of compounds, may also be made the means of expressing their physical properties.

M. Berthelot, in a note "*On Formic Acid,*" questions this; he says that the explanation of the anomaly observed must be sought through physical and mechanical experiments, and not in the imaginary arrangements of a formula. He shows that in the union of carbonic oxide and water, the synthesis of formic acid is direct, and no accessory products are formed. It is in this case that the calorific anomaly is most evident. In Kolbe's experiment, a quantity of hydrate of potash is formed, which must have some influence. M. Berthelot then compares formic with acetic acid, acids belonging to the same series, and comparable by their chemical constitution, whatever formulæ they may be represented by. But the combustion of acetic acid disengages the same amount of heat as the combustion of the products of its decomposition, carbonic acid and marsh gas, or carbonic acid, water, and acetone. No formula, he adds, will enable us to foresee the calorific properties of formic acid. In conclusion, M. Berthelot announces the speedy publication of a memoir, in which he will show that the vapour of formic acid submitted to a high temperature decomposes with a considerable disengagement of heat, and that the decomposition may be at will into carbonic oxide and water, or carbonic acid and hydrogen.

MM. Caron and Margueritte continue their dispute about *the cementation of iron by carbons and carbonic oxide.* The former says that soot will not make steel any more than graphite. The latter says what he has said before.

Two notes, one by M. Des Cloizeaux, and the other by M. Daubree, announce the discovery of Breunnerite, a crystallised carbonate of magnesia and iron, in the remarkable meteorite which fell at Orgueil. A third note, by M. Cloez, announces that the same meteorite contained a little more than one-half per cent. of carbonic acid—small facts, but valuable, since the presence of this crystallised carbonate proves that the meteorite could never have been exposed to a very high temperature.

NOTICES OF BOOKS.

Elements of Chemistry: Theoretical and Practical. Part II. Inorganic Chemistry. Third Edition, with additions. By WILLIAM ALLEN MILLER, M.D., L.L.D., &c., &c. London: Longman and Co. 1864.

THE sale of two editions of an educational work on the scale of Dr. Miller's "Elements of Chemistry," may be taken as a proof of the esteem in which it is held, and it is only necessary for us to point out the new features of this edition.

In the present state of chemical science we might say it has become a difficult matter to write a completely satisfactory educational work on chemistry. An author has two courses open to him. He may adhere to the old notation, and give in an appendix an account of new theories and systems of notation, or he may construct his book entirely upon recent theories, and leave all previous notations out of consideration. Neither of these plans we think, is altogether satisfactory. A student may never read an appendix, and consequently remain in ignorance of what it is very desirable that he should know; and if he have studied only the new notation he runs the risk of being mystified whenever he takes up a book on the old. We are thinking of a student who does not devote himself exclusively to chemistry, but who should be so taught the elements of the science that he may supplement his knowledge from our current literature, which has no system.

In this volume Dr. Miller has adopted the new atomic weights, and written all the formulæ according to it. He has, however, placed at the beginning a general note as follows:—

"N.B.—In the formulæ adopted in this volume the symbols for the new atomic weights are in accordance with the present usual and convenient practice, indicated by barred letters, instead of by italics as in the first volume. The conversion of any formula on the new notation into that in ordinary use is effected by doubling the numbers attached to the barred symbols. The result will be either the ordinary formula or its multiple by two. KHΘ, for instance, = KHO_2; and $\text{S}\!\!\!-\!oCl_4 = 2SnCl_2$."

When we have quoted this, and said that large additions have been made to this edition to bring the work up to the present state of the science, we have said all that is necessary to convince our readers of its value as an introduction to the study of chemistry.

A Manual of Qualitative Analysis. By ROBERT GALLOWAY, F.C.S. Fourth Edition. Revised and Enlarged. London: Churchill and Son. 1864.

WE can always give praise to Mr. Galloway's educational works. They are invariably written upon a system and founded on experience, and the teaching is clear, and in general complete. Few works on qualitative analysis have been more studied than the previous editions of this manual, and the present edition will commend itself to teachers and students by some marked improvements. Nevertheless, it would not be difficult to find fault with the book. The system does not appear to us perfect. We are puzzled, for instance, on reading par. 27 by finding an asterisk directing us to a foot-note which tells the student to pass on to par. 96, the information given between these two paragraphs being absolutely necessary for the proper understanding of what follows. We notice also some small omissions. The author, for instance, forgets to mention that most delicate and characteristic test for sulphur, nitroprusside of sodium. We object also to the constant use of marks of quotation with and without references to the authorities. These quotations swell the book to unnecessary dimensions, when the simple mention of a fact with a reference at the bottom of the page would answer every purpose. Lastly, we would recommend Mr. Galloway to reconsider Part II., the greater part of which might well be omitted from this book, and largely added to in a separate work. The subject of systematic proximate organic analysis has not yet received the attention it deserves.

Annalen der Chemie und der Pharmacie. October, 1864.

(Continued from page 250.)

THE next paper is by Arnulf Schertel "*On Sulphonaphthalic Acid and Bisulphide of Naphthalin.*" Vogt has shown that by the action of nascent hydrogen chlorosulphophenylic acid is changed into phenylmercaptan, and Kolbe had speculated that in a similar way chlorosulphonaphthalic acid would be changed into sulphhydrate of naphthalin

$$\left.\begin{matrix}C_{20}H_7\\H\end{matrix}\right\}S_2,$$

and bisulphide of naphthalin $(C_{20}H_7)S_2$.

The author's experiments proved that these changes really take place. He kept the chlorosulphonaphthalic acid in contact with nascent hydrogen (from zinc and dilute SO_3) for twenty-four hours, and then by distillation obtained a heavy disagreeable smelling oil, which, after rectification, was analysed, and found to be the sulphohydrate expected. It is a light, refractive liquid, with a faint disagreeable odour, is soluble in ether and alcohol, but not miscible with water. Like all mercaptans it easily exchanges an atom of hydrogen for a metal.

The author describes the compounds with mercury, lead, and copper. An alcoholic solution saturated with ammoniacal gas, and left in the air for some days, deposited yellow transparent crystals of bisulphide of naphthalin, $C_{20}H_7S_2$. This body on treatment with nascent hydrogen reverts to the former compound.

This paper is followed by a communication, "*On Some Derivatives of Mucic Acid,*" by F. Bode. Lies-Bodart had observed that mucic acid heated with pentachloride of phosphorus, and treated with water, gave rise to a new acid with the composition—$2HO,C_{12}H_2Cl_2O_6$. The author has further examined this acid, and some of its salts, and an ether. He obtained the acid by heating six equivalents of pentachloride of phosphorus with one equivalent of mucic acid in a retort. As the temperature rose oxy-chloride of phosphorus distilled over. At 120° C. the distillation was stopped, and the residue in the retort was poured into a large quantity of water, whereupon the new acid separated as a white, sandy powder. There seems to be nothing peculiar in the behaviour of the acid or its salts. When this acid is submitted to the action of sodium amalgam and water, another acid, free from chlorine, is obtained—$2HO,C_{10}H_4O_6$—to which the author has given the name *Muconic acid*. This acid only differs from itaconic acid—$2HO,C_{10}H_4O_6$—by two atoms of carbon and two of hydrogen, and from adipinic acid—$2HO,C_{12}H_8O_8$—by two of hydrogen. The author endeavoured to prepare an acid—$2HO,C_{12}H_4O_8$—and also to convert muconic into adipinic acid by the action of nascent hydrogen, but without success. The most peculiar property of muconic acid is the readiness with which it etherifies. It is only necessary to heat the acid with absolute alcohol to obtain a large amount of ether, which is a colourless, oily fluid, heavier than water, with an agreeable odour.

A paper, "*On Secondary Alcohols,*" by Kolbe, gives the author's views of the constitution of Wurtz's "*Hydrate of Amylene.*" It will be remembered that by treating pure amylic alcohol with chloride of zinc Wurtz obtained amylene $C_{10}H_{10}$. With this body he formed the compound $C_{10}H_{10},HI$, and now, on treating the latter compound with moist oxide of silver, he eliminated the iodine and fixed a molecule of water, thus forming a body the composition of which is represented by $C_{10}H_{10},H_2O$, a body isomeric with amylic alcohol, and which Wurtz calls hydrate of amylene. Beyond identity of ultimate composition, this compound has nothing in common with amylic alcohol, and the question arises what is it to be regarded as? Wurtz's own views on the question we shall have occasion to give presently. Kolbe, we may say shortly, regards it as a *secondary alcohol.* By a secondary alcohol the author means a body in which two of the typical hydrogen atoms in a typical alcohol are substituted by two atoms of some other alcohol radicals. Thus, starting with methylic as the typical alcohol, we may have—

$$\underbrace{\left.\begin{matrix}H\\H\\H\end{matrix}\right\}C_2O.HO}_{\text{Typical alcohol.}}\qquad\underbrace{\left.\begin{matrix}C_2H_3\\H\\H\end{matrix}\right\}C_2O.HO}_{\text{Primary alcohol.}}\qquad\underbrace{\left.\begin{matrix}C_2H_3\\C_4H_5\\H\end{matrix}\right\}C_2O.HO}_{\text{Secondary alcohol.}}$$

Now, from a consideration of the behaviour and boiling-point of pseudo-amylic alcohol, Kolbe is brought to regard it as a secondary alcohol, made up in the way represented by the formula

$$\left.\begin{matrix}C_2H_3\\C_6H_7\\H\end{matrix}\right\}C_2O.HO.$$

and to which he gives the name *Propyl-methyl-carbinol.* The word *carbinol* requires some explanation. In his work on organic chemistry the author has given the name *Carbin* to the typical radical

$$\left.\begin{matrix}H\\H\\H\end{matrix}\right\}C_2,$$

the hydrated oxide of which he designates *Carbinole*, to save the use of the longer German term, *Carbinoxydhydrat*. The whole of this most ingenious paper forms a very interesting study. We must again pass over some other papers for the present.

Annales de Chimie et de Physique. October, 1864.

In this Journal we have Wurtz's "*Memoir on Isomerism in Alcohols and Glycols,*" the first part of which is devoted to the above-named hydrate of amylene and its derivatives. We may mention in passing that this pseudo-amylic alcohol, when submitted to the action of oxidising agents, does not furnish valerianic acid, but a complex mixture composed principally of acetic acid, with which are found hydrate of butylene and various acetones. There are other differences quite as marked between the behaviour of the pseudo and the true amylic alcohol. Thus, true amylic alcohol and its derivatives only yield amylene under the influence of strong reagents, such as chloride of zinc, while hydrate of amylene and its derivates furnish amylene on the smallest provocation. The hydrate itself breaks up into amylene and water when simply heated; the acetate splits into amylene and acetic acid when it is heated. The hydriodate breaks up under the influence of ammonia. With regard to the constitution of the pseudo alcohol, the author states that when naming it hydrate of amylene, he did not mean to convey the impression that he regarded it as a binary compound of water and amylene, according to the dualistic theory. The real condition of things in the two alcohols he understands to be as follows. In true amylic alcohol five atoms of carbon (Wurtz uses the new atomic weights, Kolbe uses the old) are in direct relation or close connexion with eleven atoms of hydrogen. The twelfth unit of affinity necessary to saturate $Ꞓ_5$ is furnished by the diatomic oxygen, which is in connexion with the last atom of hydrogen. The formulæ $Ꞓ_5H_{11},ΘH$ or

$$\left.\begin{matrix}Ꞓ_5H_{11}\\H\end{matrix}\right\}Θ$$

express these relations perfectly. Now, in the hydrate of amylene or pseudo alcohol the author thinks that the eleventh atom of hydrogen is not so strongly united as the corresponding atom in the amylic group $Ꞓ_5H_{11}$. This eleventh atom of hydrogen is that which the hydriodic acid fixed upon the amylene on combining with it $Ꞓ_5H_{10},HI$. In the hydrate, in which the group ΘH replaces the iodine, the eleventh atom becomes somehow part of the radical, and saturates the affinities of a certain atom of carbon, but since it is very easily separated it seems as if this eleventh atom of hydrogen was in connexion with the entire amylene group, the atomicity of which is thus reduced by one unit. This view is expressed by the formula

$$\left.\begin{matrix}[(Ꞓ_5H_{10})''H]'\\H\end{matrix}\right\}Θ,$$

which gives us to understand that hydrate of amylene is not, properly speaking, a binary compound of amylene and water (for water does not exist in it ready formed), but that its molecule may very easily break up in the way its name suggests. We may expect a long dispute between Würtz and Kolbe respecting the nature of this body.

The other papers in this number of the *Annales* are—the memoir "*On Pyroxylin,*" by Pelouze and Maurey, which we have already published; "*Researches on Hydrocyanic Acid,*" by Bussy and Buignet, some account of which we gave in our last volume; and some "*Researches on the Organic Matters in Water,*" by Peligot, which last requires some notice.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2311. Leonard Cooke, Horwich, Lancashire, "Improvements in the manufacture of paper cloth."—Petition recorded September 21, 1864.

2497. John Ives Vaughan, Appleton-in-Widnes, Lancashire, "Improvements in the manufacture of resins and resinous substances, and in the apparatus employed therein, parts of such improvements being also applicable to the refining of coal, petroleum, and bone oils, and also paraffine and analogous acids and hydrocarbons."—Petition recorded October 11, 1864.

2511. Johannes Moller, Shaftesbury Villas, Hornsey Rise, Islington, Middlesex, "Improvements in the preparation or manufacture of colouring matter for marking-ink and other purposes."—Petition recorded October 11, 1864.

2594. Louis Henry Gustavus Ehrhardt, Richmond Road, Bayswater, Middlesex, "Improvements in the manufacture of gunpowder, and in flasks to contain the same."—Petition recorded October 20, 1864.

2635. George Tomlinson Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in the manufacture of aërated bread by the application of carbonic acid gas obtained from fermenting vegetable matters, and in the apparatus employed therein."—A communication from Struben Taylor Bacon, Boston, U.S.A.—Petition recorded October 24, 1864.

2646. Peter Dutrulle, Davis Street, Grosvenor Square, Middlesex, "Improvements in the manufacture of syrups."—A communication from Jean Jacques Grosheing and Auguste Sheurer, Logelbach, near Colmar, Haut Rhin.—Petition recorded October 15, 1864.

2666. David Laidlaw and James Robertson, Glasgow, Lanarkshire, N.B., "Improvements in exhausting, forcing, compressing, heating, cooling, and applying aeriform bodies, and in apparatus therefor."

2668. John Charlton and Henry Charlton, Strangeways, Lancashire, and John Osborn Christian, F.C.S., Manchester, Lancashire, "Certain improvements in sizing, dressing, filling, and stiffening yarns or fabrics composed of cotton, linen, silk, wool, or other fibrous materials or paper, whereby such materials are also rendered non-inflammable."

2673. William Cormack, Little Moorfields, Middlesex, "Improvements in the distillation or destructive distillation of solid matters or semi-solid matters capable of yielding fluids or gaseous hydro-carbons or other products, such as pitcoal, boghead, or other bituminous coal or shale, peat, wood, asphalts, tallow, lard, fats, or other solid or semi-solid matters, and in the machinery or apparatus employed therein."—Petitions recorded October 28, 1864.

2678. Alexander Smith and William Smith, Glasgow, Lanarkshire, N.B., "Improvements in, and relating to, centrifugal apparatus such as is used in the manufacture of sugar."

2685. James Lee Norton, Belle Sauvage Yard, London, "Improvements in tentering, stretching, and drying fabrics, and in drying yarns, wool, or other fibrous materials and paper."—Petitions recorded October 29, 1864.

2687. John Hawkins Simpson, Kilmeens, Ireland, "Improvements in electric printing for telegraphic purposes, and in the apparatus to be used for such purposes."

2690. Joseph Solomon, Red Lion Square, Middlesex, and Alonzo Galord Grant, Nottingham, "Improvements in lamps or apparatus for burning magnesium and other metallic substances."—Petitions recorded October 31, 1864.

2695. John Frederick Brinjes, Fieldgate Street, Whitechapel, Middlesex, "Improvements in apparatus for the re-burning of animal charcoal."—Petition recorded November 1, 1864.

2706. John Forster, Crow Street, and Frankfort House, Rathgan, and Harry Draper, Mary Street, and Leinster Road, Rathmines, Dublin, "Improvements in the preparation or manufacture of paper, in order to prevent the extraction or alteration of writings thereon without detection."—Petition recorded November 2, 1864.

2717. Thomas Fox, Alloa, in the county of Clackmannan, N.B., "An improved photographic process."

2723. Henry William Spencer and John Edward Ball, Willow Terrace, Upper Grange Road, Bermondsey, Surrey, "An improved method of manufacturing glue and size."—Petitions recorded November 3, 1864.

2749. Francois Henry Bickés, Rue des Messageries, Paris, France, "Improvement in apparatus for distilling."

2757. James Slack, Chorlton Works, Manchester, "Improvements in filters and filtering apparatus."—Petition recorded November 7, 1864.

2785. John Dale, Manchester, Lancashire Heinrich Caro, of the same place, and Carl Alexander Martius, Warrington, in the said county, "Improvements in obtaining colouring matters for dyeing and printing."—Petitions recorded November 9, 1864.

Notices to Proceed.

1652 William Bolivar Davis, Brooklyn, in the county of King's, New York, U.S.A., "An improved composition for preventing the fouling of ships and other vessels."—Petition recorded July 2, 1864.

1688. William Edward Newton, Chancery Lane, Middlesex, "An improved process for cleansing or clarifying impure water." A communication from Carl Johann Auguste Scheerer, Frieberg, Saxony.—Petition recorded July 7, 1864.

1705. Jean Joseph Moutié, Paris, France, "Improvements in distilling apparatus, suitable for rectifying, separating, or combining with other suitable matters, benzol, petroleum, or other more or less volatile hydrocarbons, or their derivatives, concentrating acids, treating alcoholic products, or other similar purposes."—Petition recorded July 9, 1864.

1780. Israel Swindells, Wigan, Lancashire, "Improvements in obtaining hydraulic and other cements from residuums or wastes."—Petition recorded July 15, 1864.

1813. William Edward Newton, Chancery Lane, Middlesex, "Improvements in the manufacture of, and mode of applying, explosive compounds." A communication from Alfred Nobel, Heleneborg, Stockholm, Sweden.—Petition recorded July 20, 1864.

1821. John Whitford, Liverpool, Lancashire, "Improvements in machinery or apparatus for agitating freezing mixtures, for cooling wine and other liquors or liquids, and for manufacturing ice and ice cream.—Petition recorded July 21, 1864.

1864. William Irvin, Limerick, Ireland, "An improved compound for preventing incrustations in boilers."—Petition recorded July 26, 1864.

1949. Adolph Hermann Alvin Plughaupt, Manchester, Lancashire, "Improvements in producing colour from aniline."—Petition recorded August 4, 1864.

2033. Edmund Alfred Pontifex, Shoe Lane, London, "Improvements in treating stick-lac when manufacturing shell-lac and lac dye."—A communication from Thomas Frederick Henly, Boulevart Malesherbes, Paris, France.—Petition recorded August 15, 1864.

2432. Richard Lanning, Priory Road, Kilburn, West Hampstead, Middlesex, "Improvements in making ammoniacal preparations."—Petition recorded October 4, 1864.

2583. William Buxton, Lime Tree Lodge, Rotherhithe, Surrey, "Improvements in the preparation of sheep's wool for medical purposes."—Petition recorded October 19, 1864.

2650. Bonnet Frederick Brunel, Brussels, Belgium, "Improvements in treating titanic iron sands, and in apparatus employed therein."—Petition recorded October 26, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, November 23.

WHO first discovered oxygen? Priestley! cries an Englishman; Scheele! shouts a Swede; Lavoisier! screams a Frenchman. No, says M. Cap; before all these there was a modest man, one Pierre Bayen, Pharmacien-en-Chef to the French army, who in 1772, or even earlier, was experimenting with *calxes* of mercury in the hope of finding the elements of cinnabar. And among other things he did, he heated a mercurial calx (an oxide) without charcoal, and found that it gave off an elastic fluid, which he collected, measured, and weighed, and found to be heavier than atmospheric air. But here he stopped, and the name of Bayen as the discoverer of oxygen remained until now in obscurity; where it ought still to have remained, says M. Hœffer, who shows that Bayen quoted Lavoisier, and afterwards remarks that the discovery of oxygen in the latter half of the 18th century was only the hatching of an egg which had been sat upon for ages. For in November, 1489, Eck Sulzbach discovered that artificial cinnabar (red oxide of mercury) when submitted to distillation disengaged a *spirit*. He had only to catch that spirit and give it a name, and we should have had oxygen under some designation or other. Relative to this revived dispute, M. Hœffer remarks, probably with great truth, that no great discovery has come fully developed from the head of a single man, as Minerva did from the head of Vulcan.

The *Comptes-Rendus*, which you receive regularly, I may tell you, give you a very tame idea of the proceedings of our Academy, so unlike your Royal Society. It is the correspondence which is most characteristic. Everybody with an idea, and many without any ideas here, write to the Academy; just as in London they write to the *Times*. One has a notion that he can propel a ship without either sails or steam. Will the Academy appoint a commission to investigate his scheme, and recommend the Government to take it up? Another plainly asks for advice—he thinks a navigable balloon the great want of the age; will the Academy tell him how to do it? And then the bores—M. Brachet, for example—who has sent a communication every week for the last four years, and *apropos* to whom M. Flourens lately observed that it was impossible for a man to have a good idea every week—an opinion which some people in England who listen to the same clergyman every Sunday will probably feel inclined to endorse. But, however, these things give a life and colour to the meetings of the Academy which are wanting elsewhere.

The annual Congress of German *savants*, you are no doubt aware, was held this year at Giessen. This Congress is a migratory body, like the British Association, and is, if I remember rightly, of about the same age. I was not at Giessen, but I will go to Hanover, where the Congress meets next year, if I can. According to the papers, the meeting this year was of a very enjoyable character. I have been to several meetings of the British Association, and I am bound to say that, excepting when I was on a visit to friends in the place, I found them dreadfully dull. They are all very well for the lions who get fed with flattery and other convenient food. I don't mean the Red Lions, with whom I always enjoyed myself, flourishing my tail and roaring with the rest of the caravan, and listening with more or less pleasure to the original comic songs . . and . . . always brought with them in imitation of poor Forbes. But the rest of the evenings during the meeting, and those *conversazioni!* From all scientific *conversazioni* as means of enjoyment, —— —— deliver us. Is there a soul who has not on these occasions felt some pity for a number of well-meaning men who must have come to the place with some idea of enjoying themselves, but are seen at these gatherings wandering about a crowded room with no one to speak to, and a fixed look of profoundest melancholy on their faces! Well, they do not appear to have had any *conversazioni* at Giessen, but a ball or concert every evening instead. Cannot the managers of the British Association take a hint? Surely science never was designed to make our pleasures less; and I know, at all events, some first-rate chemists in England who are excellent dancers, and some who are not bad musicians. *Definitivement*, I go to Hanover (where you will do doubt wish me), and not to Birmingham next year.

The Giessen congress was well attended by chemists. Wöhler, G. Rose, H. Kopp, Löwig, Fresenius, Strecker, Kekulé, Stas, Wurtz, and Dr. Hofmann were present. But notwithstanding and nevertheless, as some people say, the scientific results of the meeting do not appear to have been large. This may be the fault of the reporting, which has not arrived at the same degree of perfection on the Continent as it has in England. But it may be that the *savants* went to Giessen more for social enjoyment, and small blame to them if they did. To say the truth, the French reporter rather makes fun of the serious part of the Congress. There was a Schlagenweit present, he tells us—(there always used to be one or two at the British Association, with much the same story, I remember)—who informed the Congress that there were no roads among the Himalayas, and that travelling was difficult in that country, for the river-beds were stony, and horses stumbled thereon, and so on. And there was Dr. Stamm, from Berlin, who, speaking of epidemics, told his hearers that Europe was indebted for the cholera to the bad government of India by the English! I am sorry to say that no chemistry whatever is reported, and the only fact, or *on dit*, of special interest to English chemists that I can pick up is that Dr. Hofmann has already taken possession of Mitscherlich's house and laboratory, and will commence his lectures at Berlin after next Easter. It is said, however, that the doctor still intends to remove to Bonn when the great laboratory is finished. The foundation-stone of this building was laid on the 16th of September.

The Paris Photographic Society began its sittings on the 4th of this month. There was nothing of particular interest brought forward. A committee reported upon some papier-maché baths and dishes, and expressed themselves strongly in favour of them. It seems that they are not at all acted upon by the chemicals made use of, are very light and portable, and, moreover, cheap to start with and not liable to breakage.

I see a mixture of nitrate of lead and silver recommended for positive prints. I do not feel certain that the process is very new, but I send it. Wöhler, it seems, noticed that when an excess of potash was added to a mixture of nitrates of lead and silver (the former in excess), a part of the oxide of lead only was dissolved, and a compound was left said to be $AgO^{2}PbO$. Potash does not act on this compound, which is, however, very sensible to light. On that observation the following process has been founded. Immerse the paper (not salted) in a solution made of—

Nitrate of lead	. .	125 grammes
,, silver	. .	50 ,,
Distilled water	. .	1000 ,,

Dry in the dark, and then immerse in a second bath composed of—

Water	. . . .	1000 grammes
Potash	. . . .	36 ,,

Dry again, and expose under the negative. The covered parts become lightly coloured on exposure, but hyposulphite takes out this colour. The prints may be toned with gold like the ordinary silver prints.

The Salting of Meat.

To the Editor of the Chemical News.

Sir,—I was much interested in hearing at the last meeting of the Chemical Society an account of the successful application of a scheme for curing meat by injecting salt brine into the entire carcase of the recently slaughtered animal. The same idea is likely to have suggested itself to many minds independently, and my friend Mr. Mackenzie long since conceived, and, I believe, carried out, the process now described by Dr. Morgan. He soon, however, encountered a practical objection in the fact that it would be necessary to impregnate the prime joints equally with the other parts which are required to be salted, and a deterioration in value was the consequence of this universal system of treatment. Under special circumstances this objection may be overruled, but the ordinary consumer would not generally be satisfied with a salted steak or sirloin, and the fatty parts would be unfit for many purposes to which suet is applied.

In connection with the salting of meat, I was witness to an incident some nine years ago, which deserves to be noticed by way of a caution. A butcher was employing—I believe from motives of economy—a zinc lined trough for containing the brine in which meat was to be salted, and this receptacle had not long been in use before symptoms of corrosion presented themselves so forcibly as to lead to the inference that the metal was being attacked and dissolved by the mixed solution of organic matters, nitre, and common salt. A sample of this meat brine having been forwarded to me for examination, I soon found that it contained a large quantity of zinc in a soluble form, and I had no difficulty in tracing the metal by boiling with sulphide of ammonium, collecting and burning the precipitate, and moistening it with solution of nitrate of cobalt, when on subsequent ignition a bright green-coloured product was obtained characteristic of the presence of zinc. On inquiry I learned that the corrosion of the trough, and not the flavour of the meat, had prompted the suspicion that a poisonous influence might be exerted.

I am, &c. John Spiller.

Maryon Road, Charlton, November 21.

[Dr. Morgan's plan is specially applicable in countries like South America, in which the prime joints are not required for home use.]

New Minerals from Cornwall.

To the Editor of the Chemical News.

Sir,—Would you kindly insert a note in your next number to state that I some time ago discovered two new minerals associated with Langita? One is a green mineral, which I call Waringtonite, the other a whitish-blue one, which I have named Lyellite. As M. Pisani, in Paris, appears to think it not unfair to attempt to forestall me in my descriptions of this Cornish group of minerals, I am obliged to ask you this favour.

I exhibited Waringtonite and Lyellite at the Geological Society in July. But no opportunity of naming them or describing them was then afforded me, though their analysis was made in June: and, in truth, I had never dreamt that any gentleman in England or abroad would have refused to me the courtesy generally paid to every man of science in announcing a discovery—that, namely, of leaving to him the description of what he has discovered. My having no laboratory in the British Museum compelled me to go elsewhere to make the analyses, the publication of which has been delayed that I might confirm two or three determinations about the exact precision of which I felt uncertain. An absence in Russia on public business for two months, and a consequent pressure of other duties, compelled me to postpone this, and has caused the delay in my publishing what I never had any fear of being forestalled in.

My investigation of these minerals, crystallographically and chemically, will be immediately submitted to the Royal Society.

I am, &c.
Nevil Story Maskelyne.

British Museum, November 19.

Analysis of Cotton Seed.

To the Editor of the Chemical News.

Sir,—In No. 258 I find a short notice on cotton seed oil. I received a few days ago a fair average commercial sample of Egyptian cotton seed imported from Alexandria, which I analysed, the result being, in 100 parts of the finely pulverised seeds, free from adherent cotton, the following:—

Moisture driven off at 212°	9·520
Oil extracted by boiling ether	20·880
Gum, mucilage, &c., soluble in boiling water	14·000
Albuminous compounds	26·640
Woody fibre	25·185
Ash	3·775
	100·000

The seed contains no starch of the kind which yields a blue colour with iodine.

I have a sample also of the crude oil, upon which I am making some experiments; its darkish brown-red colour, somewhat resembling the colour of bromine, appears, as far as I have yet been able to ascertain, due to a peculiar principle dispersed through the seeds in very small quantity, soluble in ether, and contained in peculiar cells. It would appear that the peculiar reddish-brown colour is developed on coming in contact with the oxygen of the air. The crude oil is freely soluble in ether, which also assumes the colour.

I am, &c.,
Dr. A. Adriani.

Sugar Refining.

To the Editor of the Chemical News.

Sir,—I request you to insert in your next issue the following reply to Dr. Schwarz, condensed by me from what I wrote about three months ago:—

1. Dr. Schwarz does not give on page 92, vol. x. of your paper a sufficiently clear and explicit description of his mode of working and the apparatus therein employed.

2. Dr. Schwars departs from the rule, *qui bene distinguit bene docet*, when he says in the beginning of his latter, page 131, vol. x., "the result arrived at is totally at variance with the experience of Mr. Dumas, who has adopted it for the estimation of sugar;" every one acquainted with chemistry knows, that estimation means the quantitative determination of a substance. And so far from the use of a mixture of alcohol and acetic acid being something new for this very purpose, I can assure Dr. Schwarz that it was in pretty general use for at least so far back as 1848, and no doubt but I could point out to Dr. Schwarz that Dumas cannot but have been aware of this.

3. The use of a mixture of alcohol and acetic acid, however fit it may be to estimate sugar, has nothing whatever to do with the application on the large scale of a mixture of the same substances, or as Dr. Schwarz prefers hydrochloric acid, to purify raw sugar from molasses; it is not easy to see how, as Dr. Schwarz asserts, hydrochloric acid, certainly a less expensive article than acetic acid, should produce more readily the sugar crystals. Dr. Schwarz certainly does not mean to infer that hydrochloric acid should in reality produce sugar crystals, if the latter had not been, previous to the use of his mixture, ready formed, by the sugar-containing liquor having been boiled down to the point of crystallisation.

4. Dr. Schwarz, in the description of his process (page 92, vol. x.), does not at all say what vessels he employs, while it is further (see page 92, column 2, line 16 from the top) also somewhat left in *vago* as to what means are to be resorted to to recover the alcohol.

5. As to Dr. Schwarz's objections to the baryta process, I know that in Belgium and in France it has been found to answer; and as regards the refuse, I remind Dr. Schwarz of the existence in both these countries of the strict regulations laid down by the proper authorities for the promotion of public health and safety, under the *Loi Organique Concernant les Etablissemens Dangereux et Insalubres*, made in 1810.

6. As regards Dr. Schwarz's refutation of the objection I took to the use of acids in its effects upon the machinery and plant, I have to remind Dr. Schwarz that just in consequence of the bad effects of acids into which oils and fats are gradually converted, the greatest possible care is required to select for lubricating purposes such materials as are least apt to give rise to corrosion. Dr. Schwarz says that only organic acid is present; pray are acetic, tartaric, and other organic acids without effect upon metals like as brass, copper, iron, &c.? I have repeated the experiment mentioned by Dr. Schwarz, and left clean, pure iron wire for twenty-four hours in a mixture of one fluid ounce of strong alcohol and ten drops of pure hydrochloric acid, and found that the iron was very appreciably acted upon.

7. I did, in speaking of the use of a solution of pure refined sugar to free raw sugar from molasses, not thereby mean that this is actually a useful practical method; I only said it can be done. Dr. Schwarz, in rebuking me, forgets that *a posse ad esse non valet conclusio*. I also very well know that water may in small quantity serve that purpose, but, of course, as rightly observed by Dr. Schwarz, its use is accompanied with loss of sugar.

8. I have to remind that sugar, however pure, as obtained by the application of centrifugal machines, is not exactly the form in which that necessary of life is most appreciated and liked by the consumers. If Dr. Schwarz intends his process only to serve for obtaining a better raw sugar, then I think that, by due care in the selection of the cane or beet-root, and by applying the best mechanical means to express the juice, and the avoidance of all such influences as are known to convert a larger or smaller proportion of crystallisable sugar into non-crystallisable, and the more general introduction of vacuum pans in the manufactories of raw cane and beet-root sugar, the pro-

portion of molasses produced may be to a great extent so reduced as not to require the introduction of new and perhaps complicate apparatus, and that thus also may be avoided the use of alcohol, which, moreover, in almost all countries would meet with a difficulty in the admission of its use on account of the existing excise regulations upon spirits. As regards the use of acid, it will require on the part of the workmen more care to take and apply it (the acid) in the precise proportion than can possibly always be expected to be bestowed by working men upon such an operation. Hydrochloric acid, moreover, is frequently contaminated with impurities, among which may be arsenic, and its use also may, on that account, be taken objection to.

I am, &c.

Dr. A. Adriani.

MISCELLANEOUS.

The Pharmacy Bill.—A deputation of the Council of the Pharmaceutical Society of Great Britain, consisting of Mr. Sandford (President), Mr. Hills (Vice-President), Mr. Daniel Bell Hanbury (Treasurer), Mr. Squire, Mr. Morson, Mr. Waugh, Mr. Orridge, Dr. Edwards, Mr. Flux (Solicitor), and Mr. Bremridge (Secretary), had an interview with the Right Hon. Sir George Grey at the Home Office on Tuesday last, on the subject of a proposed bill for regulating the qualifications of chemists and druggists.

Illumination of Street Names.—Several attempts have been made to render the titles of the streets of Paris as visible at night as in the day time, and at last apparently with success. The labels in the neighbourhood of the Hôtel de Ville are now lighted up in the following manner:—The frame in which the letters are set is made in the form of a rectangular trough, the upper and lower portions being pierced with holes to allow of proper ventilation, and within this is a gas-pipe with a number of small jets, according to the length of the tablet, and, consequently, the number of transparent letters to be illuminated. The upper part of the box, or trough, opens to allow of lighting and repairs, and is closed by a counterpoise concealed in the stonework of the walls. We are not informed yet of the cost of this very useful arrangement.

Revived Corks.—The attention of the French public has been called by M. Stanislaus Martin to the employment of refuse corks as dangerous to public health. It is the custom of the Paris scavengers to collect those which are brought down by the sewers, and sell them to persons who make it their business to revive them. If the corks are of unsightly shape they are re-cut; while, if containing holes, these are filled up with mastic, and then smeared with a powder to give them a proper colour. Such corks used only to be employed by the ink and blacking makers, but their low price (5s. 6d. per 1000) has of late induced retailers of bottled beverages to purchase them. M. Martin asks if there be not ground for alarm lest some of these corks may have been formerly used to stop bottles containing poisonous substances; for although a good cork is not permeable, a bad one, full of holes, may readily become the receptacle of particles of vardigris, carbonate of lead, arsenic, or an infinity of other poisonous substances, which may be more or less soluble in water, wine, beer, cider, vinegar, milk, or oil. The *Medical Times* expresses a hope that these revived corks may never give rise to juridical errors, causing the innocent to be declared guilty.

The Patent Laws.—We learn that the following will be the most important recommendations to be made by the Royal Commission which has been appointed to examine and report upon the Patent Laws:—"1st. That the present system of obtaining and paying for letters patent ought to be maintained; but that patent fees should not be made to contribute to the general expenditure of the State until every reasonable requirement of the Patent Office has been satisfied. 2nd. That no patent be granted if it be found, after examination, that there has been any previous documental publication of the invention; but that no investigation be entered into concerning its merits. 3rd. That one of the judges should sit for the trial of patent cases exclusively; that he should be assisted by scientific assessors; should sit without a jury, unless the parties to the suit or action desire a jury; and, when sitting without a jury, that he should decide questions of fact as well as law. 4th. That the granting of licences to use patented inventions ought not to be made compulsory. 5th. That patents ought not to be granted to importers of foreign inventions. 6th. That no patent should be extended beyond the original term of fourteen years. 7th. That the Crown should be empowered to use patented inventions without having obtained the consent of the patentee, and should pay him for such use a sum to be fixed by the Treasury." These are very slight alterations, but quite as much as we expected from the Commission.

Treating Poor Lead Ores by Hydrochloric Acid.—M. H. C. Lampadius (a name classical in the annals of metallurgy), engineer of the mines at Vüseck, states that the ores of those mines, according to their richness and the specific gravity of the acid, are treated with the proper quantity of hydrochloric acid to form chloride of lead. The transformation into chloride of lead operates completely when the ores have been well prepared. This chloride is introduced into double-bottomed vats, and sprinkled with a sufficient quantity of boiling water. The solution of chloride of lead thus obtained is drawn off into reservoirs, and left to settle. The mother waters, which contain only a very minute quantity of chloride, are reserved for a new solution. The chloride is then treated with a minute quantity of pure water by metallic zinc. There is thus formed chloride of zinc, and metallic lead is separated in a dense and spongy mass, which after being washed may be melted in an ordinary furnace. The solution of the chloride of zinc is first freed from any iron that it may contain by a little chloride of lime, and the zinc is then precipitated in the form of oxide of zinc by means of calcined chalk. It may thus be utilised for zinc white, or it may be reduced and used again. As hydrochloric acid is of a moderate price, and as the expense of the zinc is covered by the sale of zinc white, this process ought to be advantageous in the treatment of ores too poor to be treated by fusion.—*Mining and Smelting Magazine.*

Errata.—In the table given in Mr. Collier's paper, page 182, for the sign of addition + in all cases read the sign of multiplication × .

ANSWERS TO CORRESPONDENTS.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

R. Warington, jun.—Received with thanks.

W. M.—The question was answered in No. 257, p. 228, under the initials "W. C. C."

M. A. B.—With every wish to oblige, we cannot find space for the communication, which, besides, contains statements which are open to contradiction.

Books Received.—"A Manual of Materia Medica and Therapeutics," by J. F. Royle, M.D., and F. W. Headland, M.D.; "Report of Experiments on the Growth of Wheat for Twenty Years in Succession on the same Land," by J. B. Lawes and J. H. Gilbert, Ph.D.; "On the Chemistry of the Feeding of Animals for the Production of Meat and Manure," by J. B. Lawes, F.R.S.; "A Treatise on Smoky Chimneys," by Frederick Edwards, Jun.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Estimation of Phosphoric Acid,
by M. Th. Schlœsing.

The estimation of phosphoric acid has been made the object of very numerous researches, and many methods have been proposed by which to effect it; nevertheless, chemists are, in certain cases, embarrassed in determining this acid. I have tried whether separation by volatilisation, which often gives such exact results, would be more successful than analysis by precipitation, when applied to phosphoric acid, and I endeavoured to extract phosphorus from the phosphates, by bringing them in contact with a fixed acid silicic, and a reducing body at a high temperature.

At present I have restricted myself to earthy phosphates, and have not investigated the alkaline phosphates, which, however, are amenable to the same method, especially M. H. Sainte-Claire Deville's process; nor have I yet studied the metallic phosphates—such as iron and nickel, which retain phosphate at a white heat.

By heating to whiteness a mixture of carbon, silica, and phosphate of lime, magnesia or alumina, the whole of the phosphorus is not extracted, owing to the unavoidable imperfection in the mixture. To avoid this drawback I replaced the carbon by a current of reducing gas, and succeeded in intimately mixing the silica and phosphate by dissolving the latter in very little nitric acid, and by adding silica to the hot liquid until it refused to absorb more. The silica was obtained by attacking silicates; by drying on a sand bath, and heating to redness, I obtained a mixture, which did not adhere to platinum, and which could be transferred when necessary with no loss whatever.

As phosphorus attacks platinum, and as it is necessary to preserve the silicate in its integrity, which could not consequently be placed in contact with porcelain, I transferred the mixture of phosphate and silica to a charcoal boat, to introduce it afterwards into a tube of Bayeux porcelain. I make this kind of boat by pouring a paste of burnt sugar and syrup through a tube made of blotting paper; after a few minutes I remove the excess affixed to the paper; next dry and then make red hot. I then cut the tube into two half cylinders, and close the ends with a paste more solid than the first. If this process comes into general use, boats of charcoal will be manufactured. The tube may be heated in various ways, but I prefer gas, as then it is not necessary to preserve the tube from contact with the combustible, and the same tube serves for several operations. Four strong blow pipes should be arranged, vertically, at equal distances, within a space of 8 centimetres, and projecting their flames on the porcelain tube, whose heated part, about 10 centimetres, is surrounded by platinum foil, and placed in a muffle composed simply of a few refractory bricks. In seven or eight minutes the tube reaches white heat.

I had some difficulty in finding a suitable reducing gas. Sulphide of carbon forms complex products, sulphide of silicium among others; hydrocarbons deposit carbon on the sides of the tube, which destroys the covering; it is the same with common gas; at last I tried carbonic oxide, which, contrary to my expectations, succeeded perfectly. Though already oxygenated, this compound is a sufficient reducer even for phosphoric acid; it must be dry, as phosphorus decomposes water at red heat, and should retain little carbonic acid, which might interfere with its reducing power.

By these means I have succeeded in completely expelling phosphoric acid from earthy phosphates. I give two experiments:—

I.

	Grammes.
Phosphoric acid	0·062
Magnesia	0·112
Silica	0·472
Weight before heating . . .	0·646

After 0·582·5 Loss 0·063·5

The silicate obtained is an uncohesive powder attackable by digesting in hot nitric acid.

A previous experiment on phosphate of alumina having shown that in the absence of another base this salt is but imperfectly reduced, I repeated the experiment after introducing lime.

II.

	Grammes.
Phosphoric acid . . .	0·124
Alumina	0·072
Lime	0·112
Silica	0·733·5
Weight before heating . .	1·041·5

After 0·918·5 Loss 0·123

The silicate produced was agglomerated in the form of a porous scoria.

In these two experiments the heating lasted half an hour; each of them consumed one and a-half litres of oxide of carbon.

Two favouring circumstances remain to be mentioned: when phosphates are free from alumina, the silicates produced abandon their bases to hot nitric acid, although they contain some excess of silica, and have undergone a high temperature. When phosphates contain alumina the silicates are again destroyed by digestion with potash at 150° to 200°; thus, in both cases, the bases can be easily determined after the removal of the phosphoric acid.

Hitherto the acid has been estimated only by difference, but when the phosphorus has been set at liberty it may be collected and estimated directly, giving to this method all the requisite certainty. The porcelain tube may be bound with a thin silver tube containing metallic copper and heated to dull red. The silver will not be attacked, and the copper will absorb the whole of the phosphorus, the quantity of which will be indicated by the increase of weight of the silver tube. But we do not in this way get a compound so well defined as might be desired: hence I prefer transforming the phosphorus into a phosphate which should realise this condition, and have chosen that of silver as being the best characterised of the phosphates.

I direct the gaseous current from a porcelain tube into a bulbed tube containing a solution of nitrate of silver. The whole of the phosphorus condenses in it, forming a black phosphide of silver, and some phosphate dissolved by the displaced nitric acid. It is essential that the bulbed tube should be heated in a water bath towards 80° or 90°; for the true combination of carbonic oxide and phosphorus mentioned in Berzelius' treatise abandons all its phosphorus only with the aid of heat. The argentic liquid is decanted into a platinum capsule and evaporated; then on the residue I pour the hot nitric acid with which I had washed the bulbs; all the phosphorus is thus converted into phosphate: I evaporate to dryness, heat until the excess of nitrate of silver is fused, and no perceptible acid vapours are disengaged. Under these conditions, the phosphoric acid takes up and unites exactly with the three equivalents of silver, constituting the tribasic phosphate; the resulting salt is washed by simple decantation on a filter, the particles fallen on the filter are washed into the platinum capsule by a jet of water from a wash bottle, and the salt is dry and weighed.

Phosphate of silver is found to possess two advantages in analytical processes: its equivalent is very heavy, and its composition is rapidly verified by the estimation of silver. It condenses a little phosphorus in the porcelain tube, but it is red phosphorus, emitting no vapour when cold, and which may be recovered without loss by rinsing out the tube with nitrate of silver and then with nitric acid: these washings are added to the contents of the bulbs.

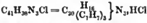
The production of tribasic phosphate of silver in presence of fused nitrate of silver is not limited to the instance I have just given; phosphates of ammonia, potash, and soda behave like pure phosphoric acid. This, then, is a very sure method of estimating phosphoric by phosphate of silver, either when alone or accompanied by an alkali, but in the absence of any earthy or metallic base.

I propose founding on the above a process for estimating the phosphoric acid in manures and earths.—*Comptes Rendus*, lix., 384.

Researches on the Colouring Matters derived from Coal-tar—No. IV. Phenyltolylamine—by A. W. HOFMANN, *LL.D., F.R.S.*[*]

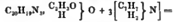
THE discovery of diphenylamine among the products of decomposition furnished by the destructive distillation of aniline blue (triphenylic rosaniline) naturally suggested the investigation of analogously constituted bodies in a similar direction. My attention has in the first place been directed to the study of a compound which, from its mode of formation, ought to be designated as toluidine blue.

When a salt of rosaniline (the acetate, for instance) is heated with double its weight of toluidine, phenomena present themselves which are similar to those observed in the analogous experiment with aniline. In the course of a few hours the rosaniline passes through all the different shades of violet, and is ultimately converted into a dark lustrous mass, which dissolves in alcohol with a deep indigo blue colour. This substance is the acetate of tritolylrosaniline. By treatment with alcoholic ammonia, and subsequently addition of water to the solution, the free base is easily obtained, from which the several salts may be prepared by the usual processes. I have examined only one of these salts, viz., the hydrochlorate. Repeatedly crystallised from boiling alcohol, this salt is obtained in small blue crystals insoluble in water, which at 100° C. contain



$$C_{41}H_{38}N_3Cl = C_{20}\left.\begin{matrix}H_{16}\\(C_7H_7)_3\end{matrix}\right\}N_3,HCl.$$

The formation of toluidine blue is thus seen to be perfectly analogous to that of aniline blue.



$$C_{20}H_{19}N_3,\left.\begin{matrix}C_2H_3O\\H\end{matrix}\right\}O + 3\left[\left.\begin{matrix}C_7H_7\\H_2\end{matrix}\right\}N\right] =$$
$$3H_3N + C_{20}\left.\begin{matrix}H_{16}\\(C_7H_7)_3\end{matrix}\right\}N_3,\left.\begin{matrix}C_2H_3O\\H\end{matrix}\right\}O.$$

I have not examined in detail the properties of this new series of colouring matters. Generally speaking, they are more soluble than the corresponding phenyl compounds, and therefore less easily obtained in a state of purity.

When one of these salts (the acetate, for instance) is submitted to dry distillation, water and acetic acid are evolved in the first place; then follow oily products, which, as the temperature rises, become more and more viscid, and ultimately solidify into crystalline masses, ammonia being abundantly evolved during the latter stages of the process. Unless the operation has been carried out on rather a large scale a comparatively small amount of a light porous charcoal remains in the retort. The oily distillate contains several bases. Those boiling at a low temperature are almost exclusively aniline and a little toluidine. The principal portion of the products boiling at a higher temperature is a beautifully crystallised base which is easily purified. By pouring cold spirit upon the interwoven crystals, a brown mother liquor containing other bases is readily separated; the residuary substance has only to be crystallised from boiling alcohol in order to procure a compound of perfect purity.

The chemical deportment of the new substance is very similar to that of diphenylamine. Like the latter it unites with acids, forming salts of very little stability, splitting up into their constituents under the influence of water, of heat, and even by mere exposure *in vacuo*. In contact with nitric acid the crystals at once assume a blue coloration, with an admixture of green, but nevertheless so similar to the analogous colour reaction of diphenylamine that by this test alone the two substances could not possibly be distinguished. The two bases differ, however, essentially in their solubility, their fusing and boiling points, and lastly in their composition. The new base is far less soluble in alcohol than diphenylamine; it fuses only at 87° C, while the fusing point of diphenylamine is 45° C.; the boiling point of the new base is 334·5° C. (corr.), at which temperature it distils without any decomposition, while diphenylamine boils at 310° (corr).

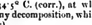
The results of analysis lead to the formula

$$C_{13}H_{13}N.$$

A hydrochlorate, crystallising in little plates, and obtained by the addition of concentrated hydrochloric acid to an alcoholic solution of the base, when dried over lime was found to contain

$$C_{13}H_{14}N,HCl.$$

Formation and chemical deportment characterise the new base as the mixed secondary monamine of the phenyl and tolyl series, as phenyltolylamine,



$$C_{13}H_{13}N = \left.\begin{matrix}C_6H_5\\C_7H_7\\H\end{matrix}\right\}N.$$

In consequence of the simultaneous existence in the molecule of the new base of the radicals phenyl and tolyl, its deportment under the influence of dehydrogenating agents became of considerable interest; and, indeed, having recognised the nature of the compound, my first experiment consisted in submitting it to the action of corrosive sublimate. Both substances unite to form a dark brown mass, which, after having been heated, dissolves in alcohol with a magnificent violet-blue colour. The compound thus produced exhibits the behaviour of the colouring matters generated from rosaniline by substitution. Owing to the peculiar properties of this class of substances, it would be difficult to prepare the new compound in sufficient quantity for a detailed examination; but, judging from its mode of generation, it will probably be found to be tolydiphenylrosaniline,

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[*] Abstract from *Proceedings* of Royal Society, vol. xiii.

$$\left.\begin{array}{c}C_{20}H_{16}\\(C_6H_5)_2\\C_7H_7\end{array}\right\}N_3,H_2O.$$

It scarcely requires to be mentioned that it is not necessary to prepare the pure toluidine blue for the purpose of obtaining phenyltolylamine. It suffices to maintain for some hours a solution of ordinary but dried acetate of rosaniline in its double weight of toluidine, in a flask provided with an upright condensing tube, at a boiling temperature, and to submit the violet-blue mass produced to destructive distillation over a naked burner. The distillate is treated with hydrochloric acid, and subsequently with water, when aniline and toluidine, together with several other basic substances accompanying the phenyltolylamine, remain as hydrochlorates in solution. The oily layer which separates generally solidifies, or may be purified by rectification. The resulting crystals are crystallised from alcohol.

The same method is also adapted for the preparation of diphenylamine, aniline being substituted for toluidine.

If I have bestowed upon diphenylamine and phenyltolylamine rather more attention than these substances at the first glance appear to claim, I have done so in the hope of gaining additional data for the investigation of the remarkable colouring matters from which these bases are derived. Both constitution and mode of formation of these colouring matters are still involved in darkness. Theory, as it often happens, has not kept pace with practice. The anticipation I expressed in a former note, that the study of the behaviour of the colouring matters under the influence of chemical agents might disclose their true nature has only very partially been realised. Up to the present moment chemists have not succeeded in giving a satisfactory account either of the atomic construction of these compounds or of the mechanism of their formation, and it would therefore scarcely be worth while to return to this question before its definite solution unless the publication of erroneous statements by M. Schiff had threatened to divert the researches of chemists from this subject.

According to M. Schiff,[†] the transformation of aniline into aniline red by means of stannic chloride is represented by the equation—

$$20C_6H_7N + 10SnCl_2 = 3(C_{20}H_{19}N_3,HCl) + 6(C_6H_7N,HCl) + H_4NCl + 10SnCl + 4C_6H_7N.$$

The formation by means of mercuric nitrate[‡] by the equation—

$$20C_6H_7N + 20HgNO_3 = 3(C_{20}H_{19}N_3,HNO_3) + 6(C_6H_7N,HNO_3) + H_4N,NO_3 + 10Hg_2NO_3 + 4C_6H_7N.$$

The latter process is accomplished at as low a temperature as 80° C., and, according to M. Schiff, is so elegant that he was enabled to make quantitative experiments. "Within a few hundredths," he says, "we have obtained the requisite quantities of the sought-for materials."

M. Schiff's equations are not conspicuous for elegance and simplicity, but they are absolutely inadmissible for other reasons. These equations utterly ignore the very essence of the process. I have pointed out, some time ago, that the formation of rosaniline involves the presence of both aniline and toluidine. Pure aniline furnishes no rosaniline, nor can this body be procured from pure toluidine. This fact I have since further established by many varied experiments, both on the small and on the large scale. The formation of rosaniline thus becomes the means of ascertaining rapidly the presence of toluidine. The amount of the latter in crude aniline[§] may become so minute that its presence can no longer be traced by distillation or by conversion into oxalates. It may be recognised, however, with the utmost facility by submitting the mixture to the action of either corrosive sublimate or arsenic acid; on application of a gentle heat the crimson colour is immediately produced.

In the equations proposed by M. Schiff there figures, moreover, ammonia as an essential term. The existence of ammoniacal salts in the crude rosaniline was pointed out some time ago by Prof. Bolley. But this ammonia (which, as I have satisfied myself, is scarcely ever absent) is, according to my opinion, not an essential product of the reaction that gives rise to the formation of aniline red. I have established by special and careful experiments that appropriate treatment of a mixture of aniline and toluidine with chloride of mercury at a moderate temperature is capable of producing very considerable quantities of rosaniline without elimination of more than a trace of ammonia. The ammonia generally observed belongs to a different phase of the reaction, being more especially due to the almost invariable production of a small quantity of aniline blue.

If we wished, even now, to represent in formulæ the relation between rosaniline and the substances which give rise to its formation, the equation,

$$C_6H_7N + 2C_7H_9N = C_{20}H_{19}N_3 + 6H,$$

might be looked upon as an expression closely approaching truth. The hydrogen figuring in this equation is eliminated in the form of water, hydrochloric, hydrobromic, hydriodic acids, &c.

But even this equation gives no account of the mechanism of this remarkable process; indeed, we cannot hope for the solution of this chemical problem before we shall have succeeded in splitting up the molecule of rosaniline into the atomic groups which enter into its composition. It is true its transformation into aniline or toluidine blue, as well as into the several violets which are generated by the substitution of alcohol radicals, prove even now that the rosaniline molecule still contains three atoms of typical hydrogen, and hence that the complex atom $C_{20}H_{16}$ functions in this triamine with the value of six atoms of hydrogen; but this, indeed, is the limit of the experimental evidence as yet obtained.

With regard to the number and nature of the simpler radicals into which the carbon and hydrogen atoms of the complex atom $C_{20}H_{16}$ are grouped, we can only speculate. Derived from the radicals phenyl, C_6H_5, and tolyl, C_7H_7, under the influence of dehydrogenating agents, this complex atom may possibly contain the bivalent radicals phenylene, C_6H_4, and tolylene, C_7H_6—

$$(C_{20}H_{16})VI. = \left\{\begin{array}{l}(C_6H_4)''\\(C_7H_6)'',\\(C_7H_6)''\end{array}\right.$$

when the molecular construction of the three colouring matters might be represented by the formulæ—

Aniline red.	Aniline blue.	Aniline violet,
$\left.\begin{array}{c}(C_6H_4)''\\(C_7H_6)_2''\\H_3\end{array}\right\}N_3,H_2O$	$\left.\begin{array}{c}(C_6H_4)''\\(C_7H_6)_2''\\(C_6H_5)_3\end{array}\right\}N_3,H_2O$	$\left.\begin{array}{c}(C_6H_4)''\\(C_7H_6)_2''\\(C_2H_5)_3\end{array}\right\}N_3,H_2O.$

[†] *Comptes Rendus*, vol. lvi., p. 271.

[‡] *Ibid.*, p. 545.

[§] Aniline obtained by distillation with potash from certain varieties of indigo is apt when treated with corrosive sublimate to furnish traces of rosaniline. I infer from this result that aniline thus produced contains a small proportion of toluidine. The formation of this substance from indigo would be as readily intelligible as the conversion under certain conditions of indigo into salicylic acid, a fact established by Cahour's observations. Aniline prepared from crystallised isatin does not yield a trace of rosaniline.

We must not, however, forget that this is simply an hypothesis, and that the elements in the complex atom $C_{20}H_{16}$ may be associated in a great variety of other groups. An interesting observation quite recently made by Dr. Hugo Müller, and communicated to me by my friend while these pages are passing through the press, may possibly assist in further elucidating the nature of this class of bodies. Dr. Müller has found that rosaniline and its coloured derivatives are instantaneously decolorised by cyanide of potassium, a series of splendidly crystallised, perfectly colourless bases being produced. The composition of these bodies, which will probably be found analogous to a substance similarly obtained from harmaline by Fritzsche, remains to be established.

On Thallic Alcohols, by M. Lamy.

Among the various compounds of thallium, I have already mentioned the existence of a liquid possessed of very curious physical properties (*Comptes Rendus*, lv., 837). This liquid, which I called "thallic alcohol," on account of the similarity of composition with potassic alcohol which I have supposed it to possess, was remarkable for its density, which was three and a-half times greater than that of water, whilst, according to a superficial examination, it equalled in refracting power sulphide of carbon.

I have since studied more carefully this curious compound, and found it to be not only heavier than all known liquid compounds, but in its power of refraction and dispersion greater also.

In the hope of obtaining a liquid still more extraordinary with respect to its optical properties, I was led to investigate a homologous compound produced by fusel oil or amylic alcohol, the molecule of which is about twice as heavy as that of ethylic or ordinary alcohol. I obtained, in fact, a compound which may be called amylthallic alcohol, but the density of which, as also the refraction, though very considerable, are not relatively so great as I had supposed them to be.

Finally I endeavoured to produce methylthallic alcohol with wood spirit.

The following are the results of my observations on the three alcohols, ethyl-thallic, amyl-thallic, and methyl-thallic:—

I will only give an abstract of the principal properties and the method of preparation of these three compounds.

Ethyl-thallic alcohol—

$$\left.\begin{matrix}C_4H_5\\ Tl\end{matrix}\right\}O,$$

and amyl-thallic—

$$\left.\begin{matrix}C_{10}H_{11}\\ Tl\end{matrix}\right\}O,$$

are both liquid at the ordinary temperature. Prepared with the subjoined precautions their respective densities are at the temperature 0° 3·550; 2·465, and their indices of refraction, at 20°, 1·678 and 1·572; for the ray D in the spectrum.

Methyl-thallic alcohol is solid.

The indices of refraction corresponding to the rays B and H of ethyl-thallic alcohol are 1·661 and 1·759, the difference of which, which measures the dispersive power, is 0·098; while the difference of the corresponding indices of sulphide of carbon (1·614 and 1·693) taken at the same temperature is only 0·079, or 0·019 less than the preceding.

Ethyl-thallic alcohol is, then, the heaviest, the most refractive, and at the same time the most dispersive of light of all known liquids.

The same liquid crystallises about 3° below zero, while amyl-thallic alcohol will not crystallise at 20° below zero.

Neither of them can be boiled without decomposing; when distilled they give, among other remarkable products, pure hydrogen, alcohol, the salt of an oxygenated acid corresponding to this alcohol, and an abundant residue of metallic thallium.

The three compounds burn in the air with a flame more or less bright and green, leaving as residues black oxide, with small buttons of the metal. All three are soluble in the corresponding alcohol and in ordinary ether; when the ether is pure and anhydrous, the etherial solution remains limpid. But if the ether is more or less aqueous, or if it has been for some time in contact with the air, it gives a yellowish solution, which gradually deposits radiating crystals of hydrated protoxide of thallium, becoming brown under the oxidising action of aërated ether. This reaction is extremely sensitive.

Chloroform also dissolves thallic alcohols; the two liquids more easily than the solid. But soon the solution which was limpid becomes cloudy, yellow, and deepening in colour, deposits a relatively considerable quantity of crystallised protochloride thallium. Formic acid is produced at the same time, and also a photogenic matter very sensible to the action of light, which communicates its brown colour to the chloride.

Thallic alcohols are decomposed more or less easily by water or atmospheric moisture. Hydrated oxide of thallium is set at liberty, and the corresponding alcohol regenerated. They are also decomposed by acids; nevertheless, carbonic acid seems to form a solid, definite compound.

Sulphide of carbon acts strongly upon them, the compounds produced varying with the relative quantity of the elements placed in contact.

Ethyl-thallic alcohol is prepared as follows:—Put a large excess of absolute alcohol in a large flat-bottomed vessel, under the receiver of an air-pump, and above the liquid very thin plates of thallium, supported by wire-gauze. Form a vacuum in the receiver, to remove, with the air, the moisture and the carbonic acid contained in it, and finally put the receiver in communication with a bag of oxygen, by means of tubes filled with sulphuric acid and pumice, and another with potash.

At 20 or 25° the thallium is rapidly transformed into a heavy oil, which falls through the alcohol to the bottom of the vessel. In this way, without touching the apparatus, a hundred grammes of heavy oil are easily produced in twenty-four hours.

Amyl-thallic alcohol may be prepared in the same way with amylic alcohol; but the slowness of the action makes the following process preferable:—Mix, in exactly equal proportions, amylic and ethyl-thallic alcohol, and distil at a temperature which should not exceed 140°.

But these methods do not succeed with methyl-thallic alcohol, because this compound covering the leaves of thallium with a solid crust prevents the action of the oxidising vapours. It is, however, very easily obtained in the form of a granulated white precipitate by simply pouring an excess of methylic alcohol on one of the two liquid thallic alcohols.

From the existence of the three compounds formed by the best known thallic alcohols, it may naturally be inferred that analogous compounds may be formed with the very numerous alcohols now known.—*Comptes Rendus*, lix., 780.

On the Chemical Constitution of Reichenbach's Creosote, by HUGO MULLER, *Ph.D.*[*]

ON heating pure creosote boiling (in hydrogen) at 219° C. with hydriodic acid, the author found that iodide of methyl distilled over, and a residue was left in the retort which readily dissolved in water, with the exception of a small quantity of heavy brown oil, which contained unaltered creosote. The aqueous solution was mixed with a large quantity of water, and partly saturated with carbonate of barium, the clear liquid filtered off and precipitated with acetate of lead, the white precipitate well washed and decomposed with sulphuretted hydrogen. The sulphide of lead having been filtered off, the aqueous solution was carefully evaporated, by which a thick heavy liquid was obtained. The reactions of this liquid so closely resembled those of pyrocatechine or oxyphenic acid, that the author would be inclined to consider it identical with this substance if it were not for the apparent impossibility of obtaining it in a crystalline form.

The author has not yet determined the composition of the liquid substance, but so far as he has investigated its chemical nature, he thinks it more than probable that the substance bears the closest analogy to oxyphenic acid ($C_6H_6O_2$), and is in all probability its homologue.

The described decomposition of creosote may be expressed in the following way:—

$$\underbrace{C_8H_{10}O_2}_{\text{Creosote.}} + HI = \underbrace{CH_3I}_{\text{Iodide of Methyl.}} + C_7H_8O_2.$$

According to which creosote may be regarded as methylated oxytolylic acid or oxycressylic acid. This view is supported by the general properties of creosote, and the fact that a lower homologue of creosote and free oxyphenic acid exist among the products of the distillation of wood.

TECHNICAL CHEMISTRY.

On the Occurrence of the Diamond in Brazil, by MM. HENSSER *and* CLARAZ.[†]

IN the Brazilian plains which constitute the diamond region, the granitic gneiss which forms the coast alternates with quartzite and crystalline schists. Of these rocks the most important is the quartzite, to which Eschwege has given the name *itacolumite*. It is a sort of sandstone, granular and friable, often contains talc, chlorite, and mica, and generally possesses a schistose structure. It is sometimes traversed by veins of quartz containing pyrophyllite similar to that found in the Ural mountains.

Itacolumite is no doubt a metamorphic rock, which was originally deposited by the water; it contains no fossil remains, but shows distinct traces of waves.

The metamorphic schist presents very varied characters. It contains quartz, which is sometimes associated with chlorite and talc, and sometimes with mica; in the last case it passes into mica-schist. Hornblende is never found in the varieties of the schist which are worked for diamonds. Sometimes the schistose character of the rock is lost, and it then contains more or less oxide of iron.

Very often the metamorphic schist passes quite imperceptibly into argillaceous schist containing talc, mica, and disthene; and also just as imperceptibly into itacolumite. Besides the minerals before mentioned, the metamorphic schist sometimes encloses limestone, schistose, oligist, and *itabirite*.

Itabirite is simply a variety of schistose oligist which is accompanied by quartz and mica. It sometimes forms thick and extensive beds, which might be worked for iron. When in a pulverulent condition it is known by the name of *jacotinga*, and the valuable English mine of Gongo Socco is worked in a deep bed of this mineral.

Limestone is also found in deep beds having numerous caverns which are rich in bones and saltpetre.

Itacolumite and the metamorphic schist are generally found in alternate layers. The direction of these beds follows the general direction of the mountains, which is nearly always north and south; they dip towards the east. They have been dislocated, so that they form abrupt and bare rocks, which in the case of itacolumite are traversed by numerous rounded channels. Both rocks are very subject to decomposition. In itacolumite, which is essentially quartzose, the decomposition is specially characterised by a *fissuration* of the rock, which falls to dust. In the metamorphic schist, the chemical and physical properties are modified by the hydrated oxide of iron set at liberty, which ordinarily furnishes a cement for new rocks. When the rock decomposed is very rich in iron, that in the neighbourhood of itabirite, for example, it sometimes forms a breccia, which is generally composed of angular fragments of more or less altered schist, cemented together by the hydrated oxide of iron.

The metamorphic schist sometimes decomposes to a great depth, changing to an earthy mass, which in the rainy season is converted into mud. The depth of the decomposition is somewhat astonishing in the tropics, since it is not assisted by the action of snow and ice. It is no doubt caused by the violence and frequency of tropical rains, and the solvent action of the water increased by the temperature. The water also, it must be remarked, contains nitric acid, in consequence of the storms which follow with great regularity during several months of the year.

Among the products of the decomposition of itacolumite and the metamorphic schist are found many rare minerals—the diamond, euclase, topaz, chrysolite, cymophane, transparent and alusite, tourmalines, amethysts, &c.

Experience has taught the miners to look for diamonds in the distinct regions which have been named,—1. *Serrico da Serra;* 2. *Servico do Campo;* 3. *Serrico do Rio;* these three regions correspond exactly to itacolumite, to the metamorphic schist, and to the breccia spoken of before.

In the *Serrico da Serra* the decomposed itacolumite, called *gurgulho*, forms pure quartzy sand with fragments of the undecomposed rock and quartz. It fills the cavities caused by the destruction of the rock. Associated with the diamonds are always found rutile, anatase, and oxide of iron; and the presence of these minerals is always taken as indication that the earth contains diamonds. All these minerals are found in itacolumite, though difficult to distinguish without a previous washing; and the diamond has been obtained by blasting and washing the undecomposed rock.

2. The gurgulho of the *Servico do Campo* is found on the raised plains or plateaus, and not on the mountains. In occurs on the surface of the soil about the separation of the two great basins of San Francisco, and Jequitinhonha, and must have been formed *in situ* by the de-

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[*] Communicated to the Royal Society.

[†] Abridged from the *Annales des Mines*, t. xvii., p. 189.

composition of subjacent rocks. Beneath the gurgulho, the rock forms a soft mass, which can be easily removed with a hoe. Since 1850 the soft rock has been worked to a great depth, with very good results. Between the *barro*, as the softened rock is termed, and the gurgulho, or completely decomposed rock, a transition layer is found, which is named *terra*, and in which diamonds are also found.

Everything seems to indicate that the barro is produced by the decomposition of the metamorphic schist. It is true that the diamond has never been found in the schist, but this is easily explained by the fact that the undecomposed rock has never been worked. When first dug out the barro is moist and soft, but it hardens in the air, and the diamonds are not at once detached in the washing. At Dinmantina the authors obtained a specimen which still enclosed a very large diamond.

3. The *Servico do Rio* includes the works established in the beds and on the banks of the rivers. In these the diamonds are found free from the usual gangue. The bed of the river is formed by the solid rock. The moveable soil resting upon the rock is often covered with large blocks obviously belonging to the itacolumite. When oxide of iron exists in the vicinity, the upper layers are seen to be cemented into a conglomerate (canga) in which diamonds are not unfrequently found.

The moveable soil (*cascalho*) contains products of the decomposition both of itacolumite and metamorphic schist; the minerals found are the same as those in *Servico da Terra*, and the *Servico do Campo*, but the forms are rounded, and sometimes one and sometimes the other predominates. The cascalho, it must also be remarked, contains quartz ornaments, flint implements, and bones, on the nature of which latter the authors do not venture to express an opinion.

Beyond all doubt itacolomite and the metamorphic schist are the ordinary repositories of the diamond and all the precious stones which accompany it, but they are not necessarily found in all parts of the formation any more than the green tourmaline of Campo Longo, and the realgar of Binnenthal are seen in all the dolomites of the Alps.

The diamond is found in the mountains of itacolomite of Grao Mayor, and in the numerous water-courses which take their rise in them; it exists, also, in many other mountains of itacolomite, but is too rare to be sought for profitably. Thus, in the Serra do Cipo, in the basin of San Francisco, we have seen four diamonds which were found in a small water-course at the upper part of the serra. On the other side the mountains may not contain diamonds, and this may be the case with Itacolomi itself, which has given the name to the rock.

Up to the present time the decomposed metamorphic schist of San Joao or Quioda is the only one in which the diamond has been observed; but the great extent of the *gurgulho do campo* shows that the schist is very widely spread, and diamonds may be found in various localities.

PHYSICAL SCIENCE.

On Drops.

Mr. Guthrie, Professor of Chemistry and Physics at the Royal College, Mauritius, has made to the Royal Society an elaborate communication on Drops, from which we extract portions which have some practical interest to pharmaceutists and prescribers:—

The author defines a drop as a mass of liquid collected and held together by the attraction of its parts, and separated from other matter by the attraction of gravitation. It follows that the size of a drop may depend upon, and be influenced by, variation in—

1. The self-attraction and cohesion of the drop-generating liquid;
2. Its adhesion to the matter upon which the drop is formed;
3. The shape of the matter from which the drop moves;
4. The physical relation of the medium through which the drop moves, on the one hand, to the liquid of which the drop is formed, and on the other, to the matter on which it is formed;
5. The attraction of the earth, or gravitation, upon the drop-forming liquid and upon the medium, as influenced by their respective and relative densities, and by variation in the attracting power of the earth.

When a liquid drops from a solid through a gaseous medium, as atmospheric air, it may be asserted that a drop of the liquid will always be of the same size, if it is formed of the same liquid substance, and falls from a solid of the same substance, size, and shape, provided that the temperature remain the same, and the growth time, or length of the time interval between the successive drops, be constant.

We need not describe the plan adopted by the author for ensuring the regularity of the drops, which would indeed be unintelligible without a drawing; we must say, however, that the size of the drops was determined by weighing a noted number of them. The most prominent fact noticed by the author is that, on the whole, the drops undergo a continuous diminution in weight or size as the growth time increases. To such an extent is this the case that drops falling at the rate of sixty drops in twenty seconds were nearly twice as heavy as drops falling at the rate of one in every twelve seconds. This connexion between rate and weight (or quantity), the author very properly remarks, should not be lost sight of by prescribers and dispensers of medicine. A pharmacentist who administers 100 drops of a liquid drug, delivered at the rate of three drops per second, may give half as much again as one who measures the same number at the rate of one drop in two seconds, and so on. The cause of this difference, it is observed, is probably to be sought for in the circumstance that when the flowing to the solid is more slow, the latter is covered with a thinner film of liquid, so that, as the drop parts, the solid reclaims by adhesion more of the root of the drop than is the case when the adhesion of the solid to the liquid can satisfy itself from the thicker film which surrounds the drop in the case of a more rapid flow.

Without detailing the numerous experiments made by the author to ascertain the sizes of drops obtained from various liquids under different conditions, we may quote the laws into which he collects the main results of his experiments in the case we have mentioned—namely, a liquid dropping from a solid through a gas.

Law 1.—The drop size depends upon the rate of dropping. Generally, the quicker the succession of the drops, the greater is the drop; the slower the rate, the more strictly is this the case. This law depends upon the difference, at different rates, of the thickness of the film from which the drop falls.

Law 2.—The drop size depends upon the nature and quantity of the solid which the dropping liquid holds in solution. If the liquid stands in no chemical relation to the solid, in general, the drop size diminishes as the quantity of solid contained in the liquid increases. The cause of this seems to be that the stubborn cohesion of the liquid is diminished by the solid in solution. When one or more combinations between the liquid and solid are possible, the drop size depends upon indeterminate data.

For example: certain variations in the drop size of solutions of chloride of calcium of different strengths point to the existence of definite hydrates; while the regularity of the variation of drop size in the case of nitrate of potash points to the absence of hydrates.

Law 3.—The drop size depends upon the chemical nature of the dropping liquid, and little or nothing upon its density. Of all liquids examined, water has the greatest, and acetic acid the least drop size.

It is remarkable that butyric acid, which has sensibly the same specific gravity as water, gives rise to a drop less than half the size of the water drop.

Law 4.—The drop size depends upon the geometric relation between the solid and the liquid. If the solid be spherical, the largest drops fall from the largest spheres. Absolute difference in radii takes a greater effect upon drops formed from smaller, than upon those formed from larger spheres. Of circular horizontal planes, within certain limits, the size of the drop varies directly with the size of the plane.

The fact that the drop increases in size according as the radius of the sphere increases from which the drop falls, and that the difference from this cause may amount to half the largest drop-size, the author regards as important to dispensers of medicine. The lip of a bottle from which a drop falls is usually annuloid. The amount of solid in contact with the dropping liquid is determined by the size of two diameters, one measuring the width of the rim of the neck, the other the thickness of that rim. In most cases the curvature and massing of the solid at the point whence the liquid drops is so irregular as not to admit of any mathematical expression.

Law 5.—The drop-size depends upon the chemical nature of the solid from which the drop falls, and little or nothing upon its density. Of all the solids examined antimony delivers the smallest, and tin the largest drops.

Law 6.—The drop-size depends upon temperature, generally the higher the temperature the smaller the drop. With water the effect of a change of temperature of 20° C. to 30° C. is very small.

Law 7.—The nature or tension of the gaseous medium has little or no effect upon drop size.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 17.

Professor A. W. Williamson, Ph.D., F.R.S., *President, in the Chair.*

(Continued from page 257)

Professor Wanklyn read a paper "*On the Nature of Compound Ethers*," in which he proposed to classify the compound ethers accordingly as they are—so to speak—salts of the acid-forming or of the alcohol-forming radicals which they contain.

Class I. comprehends ethers in which the acid-forming radical is replaceable. To it belong the ethers of the fatty and aromatic acids, the oxalic ethers, the carbonic, silicic, and boracic ethers, and some others. Certain characters are common to these ethers:—(*a*.) The alkali-metals, potassium and sodium, displace the acid-forming radicals when they act upon ethers of this class. In the case of the mono-basic ethers, *e.g.*, valerianic ether, benzoic ether, the products resulting from this reaction are ethylate* of the alkali metal, and the acid-forming radicals, *e.g.*,

$$Na_2 + 2\left.\begin{array}{r}C_2H_5\\C_5H_9O\end{array}\right\}O = (C_5H_9O)_2 + 2\left.\begin{array}{r}C_2H_5\\Na\end{array}\right\}O.$$

In the case of polybasic ethers the results of the reaction are, ethylate* of the alkali metals and either the acid-forming radical itself or else an ether of a reduced acid. (*b*.) Organo-metallic bodies, such as zinc-ethyl, should give a metallic salt of the oxide of the alcohol radical and either a ketone or a reduced acid. The author expected zinc-ethyl would react upon acetate of ethyl, as represented in the following equation:—

$$\left.\begin{array}{r}C_2H_5\\Zn\frac{1}{2}\end{array}\right\} + \left.\begin{array}{r}C_2H_5\\C_2H_3O\end{array}\right\}O = \left.\begin{array}{r}C_2H_5\\C_2H_3O\end{array}\right\} + \left.\begin{array}{r}C_2H_5\\Zn\frac{1}{2}\end{array}\right\}O.$$

Here the metallic salt of the oxide of the alcohol-radical is ethylate of zinc; the ketone is ethyl-acetyl. On polybasic ethers the action of the organo-metallic bodies should be very similar—it should give a metallic salt of the alcohol radical and an ether of a reduced acid when it did not give a ketone. Frankland's research on the action of zinc-ethyl on oxalic acid supplies an example:—

$$1.\ \left.\begin{array}{r}C_2O_2\\C_2H_5\\C_2H_5\end{array}\right\}O_2 + Zn\tfrac{1}{2}C_2H_5 = \left.\begin{array}{r}C_2H_5\\C_2O_2\\C_2H_5\end{array}\right\}O + \left.\begin{array}{r}C_2H_5\\Zn\frac{1}{2}\end{array}\right\}O.$$

$$2.\ \left.\begin{array}{r}C_2H_5\\C_2O_2\\C_2H_5\end{array}\right\}O + Zn\tfrac{1}{2}C_2H_5 = \left.\begin{array}{r}C_6H_{10}O\\C_2H_5\\Zn\frac{1}{2}\end{array}\right\}O_2.$$

The first equation is strictly according to the theory; the second is a secondary action of zinc-ethyl upon the product of the first. Frankland's research on borate of ethyl affords an example of the action of an organo-metallic body on a tribasic ether.

$$\left.\begin{array}{r}B'''\\(C_2H_5)_3\end{array}\right\}O_3 + 3Zn\tfrac{1}{2}C_2H_5 = 3\left.\begin{array}{r}Zn\frac{1}{2}\\C_2H_5\end{array}\right\}O + \left.\begin{array}{r}B'''\\(C_2H_5)_3\end{array}\right\}$$

wherein ethide of boron represents the ketone of the tribasic radical. (*c*) Potash or soda in alcoholic solution gives, with ethers of this class, a salt of potash or soda and an alcohol, but never an ether, thus:—

$$\left.\begin{array}{r}C_5H_9O\\C_2H_5\end{array}\right\}O + \left.\begin{array}{r}H\\K\end{array}\right\}O = \left.\begin{array}{r}H\\C_2H_5\end{array}\right\}O + \left.\begin{array}{r}C_5H_9O\\K\end{array}\right\}O.$$

(*d*) Ethylate of potassium or ethylate of sodium gives no ether, *e.g.*—

$$\left.\begin{array}{r}C_5H_9O\\C_2H_5\end{array}\right\}O + \left.\begin{array}{r}K\\C_2H_5\end{array}\right\}O = \left.\begin{array}{r}K\\C_2H_5\end{array}\right\}O + \left.\begin{array}{r}C_5H_9O\\C_2H_5\end{array}\right\}O.$$

(*e*) Ammonia gives with ethers of this class an amide, *e.g.*—

$$\left.\begin{array}{r}C_5H_9O\\C_2H_5\end{array}\right\}O + \left.\begin{array}{r}H\\NH_2\end{array}\right\} = \left.\begin{array}{r}H\\C_2H_5\end{array}\right\}O + \left.\begin{array}{r}C_5H_9O\\NH_2\end{array}\right\}$$

In all these reactions it is, as will be noticed, the acid-forming radical—not the alcohol-forming radical, which is exchangeable. Adopting a nomenclature in accordance with these notions, we should have—

New.		Old.
Ethylate of valeryl	=	Valerate of ethyl.
Ethylate of acetyl	=	Acetate of ethyl.
Amylate of acetyl	=	Acetate of amyl.
Tri-ethylate of boron	=	Borate of ethyl.
&c.		&c.

Class II. comprehends ethers which are true salts of the alcohol-radical, wherein the alcohol-radical, and not the acid-forming radical, is replaceable. To it belong—

Iodides	of alcohol-radicals.
Bromides	„
Chlorides	„
Nitrates	„
Nitrites	„
Fluorides (?)	„

And some others.

The characteristics of Class II. are quite different from those of Class I. Thus the members of Class II. give with (*a*) metals, alcohol radicals; (*b*) organo-metallic bodies, double alcohol radical; (*c*) potash or soda, an ether, and sometimes an alcohol besides; (*d*) ethylate of potash or soda, a double ether; (*e*) ammonia, a compound ammonia. It is thus seen that the members of Class II. exhibit the alcohol radical contained in them as the moveable portion. They should, therefore, retain their old names.

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* Ethylate, or methylate, or amylate, &c., as the case may be.

Class III. may, perhaps, be made to embrace common ether, the anhydrides, &c., being made up of compounds in which the radicals are equally replaceable.

The foregoing classification is intended by the author to serve as a sort of programme for the work which he has chalked out for himself. Many of the characteristics assigned to the different ethers are at present known to belong to them; others—as, for example, the production of ketones by the reaction of organo-metallic bodies on the fatty ethers—are not at present known to be applicable to those ethers. The author is engaged in making experiments with the view of establishing the justice of this classification.

Professor **Wanklyn** also read a "*Note on Valerianate of Ethyl and Acetate of Amyl.*" These ethers are isomers, both having the formula $C_7H_{14}O_2$. In the text-books both are said to boil at 133° C. The author has recently made the observation that whilst the boiling point of valerianate of ethyl is actually 133° C., acetate of amyl boils at 141° C.; and Mr. Wanklyn believes that former observers have not had their acetate of amyl free from amylic alcohol, and attributes the low boiling point which they have assigned to it to the presence of the alcohol. An organic analysis will not reveal the presence of 5 per cent. of amylic alcohol in a specimen of acetate of amyl; and if a trace of moisture be also present, it will hardly show the admixture of 10 per cent. Mr. Wanklyn prepared his acetate of amyl in the usual manner, excepting the employment of a double proportion of sulphuric acid; and the product was twice digested with chloride of calcium to ensure its perfect dryness. It was incidentally noticed that the calcium salt was soluble to the extent of about 5 per cent. in acetate of amyl. For its analysis the author employed an alkalimetrical method, which he considered offered advantages over the ordinary process of combustion.

Dr. **Frankland**, after offering some speculative views upon the possible nature of the reaction exerted between potassium and boride of ethyl, proceeded to give a sketch of some experiments recently performed by Mr. Duppa and himself, in which sodium was made to act upon mixtures of acetic ether with the iodide of methyl or of ethyl; they had already succeeded in producing two new bodies having the formulæ—$C_8H_{14}O_3$ and $C_9H_{16}O_3$ respectively, the first being, of course, derived from the iodide of methyl, and the second from the ethyl compound. The formula of leucic ether, $C_8H_{16}O_3$ stood in close relationship with the new bodies, but their constitution was not yet sufficiently defined to permit of any further statement being made in regard to them.

Professor **Wanklyn** said he could not throw light upon the inquiry started by Dr. Frankland with reference to the boride of ethyl. By acting with sodium upon acetic ether, the speaker did not succeed in isolating the radical, acetyl; it seemed at the moment of liberation to unite with the elements of ethylate of sodium, and produce leucate of soda. A similar reaction was observed in the case of the decomposition of acetate of amyl by sodium.

The meeting was then adjourned until December 1, as already announced.

LECTURES ON CHEMICAL PHILOSOPHY.—VII.

Delivered at the College of France, by M. A. **Wurtz.**

Condensed Types.

(Continued from page 158.)

We may follow out in other compounds the analogy we have sought to establish between the diatomic, mineral, and organic hydrates. Thus, glycol forms two chlorides—

$$\underbrace{\left.\begin{matrix}(C_2H_4)''\\ H\end{matrix}\right\}O \atop Cl}_{\text{Monochlorhydric glycol.}} \qquad \text{and} \quad \underbrace{(C_2H_4)''Cl_2}_{\text{Dichloride of ethylene.}}$$

In the same way hydrate of copper forms two chlorides:

$$\underbrace{\left.\begin{matrix}Cu''\\ H\end{matrix}\right\}O \atop Cl}_{\text{Cupric monochlorhydrine.}} \qquad \text{and} \quad \underbrace{Cu''Cl_2}_{\text{Dichloride of copper.}}$$

The compound

$$\left.\begin{matrix}Cu''\\ H\end{matrix}\right\}O \atop Cl$$

is not known, but there does exist an analogous fluorhydric compound—

$$\left.\begin{matrix}Cu''\\ H\end{matrix}\right\}O \atop Fl$$

which was discovered by Berzelius, who attributed to it the formula CuO,CuFl,HO, which may be compared with our own, if we double the atomic weights of the oxygen and copper.

The formulæ of glycol and cupric hydrate further inform us that there ought to exist two ethylenic amides, and two cupric amides. The two former have been produced:

$$\underbrace{\left.\begin{matrix}(C_2H_4)''\\ H\end{matrix}\right\}O \atop NH_2}_{\text{Oxyethylenamine.}} \qquad \text{and} \quad \underbrace{(C_2H_4)''2NH_2}_{\text{Ethylene-diamine.}}$$

The first of these bodies is formed by the direct addition of oxide of ethylene to ammonia—

$$\underbrace{(C_2H_4)''O}_{\text{Oxide of ethylene.}} + NH_3 = \underbrace{\left[\left.\begin{matrix}(C_2H_4)''\\ H\end{matrix}\right\}O\right]'NH_2}_{\text{Oxyethylenamine.}}$$

We may regard it as ammonia in which H has been replaced by the monatomic group $[C_2H_4,HO]$. Ethylene-diamine results from the substitution of $(C_2H_4)''$ for H_2 in two molecules of ammonia.

In the same way there exist cupric, cobaltic, and platinic ammonias. To take only one example:—We may compare platosonium, that is to say, the radical of the green salt of Magnus with ethylene-diamonium—that is, the ammonium corresponding to ethylene-diamine.

$$\underbrace{\left.\begin{matrix}(C_2H_4)''\\ H_2\\ H_2\\ H_2\end{matrix}\right\}N_2Cl_2}_{\text{Chloride of ethylene-diammonium.}} \qquad \underbrace{\left.\begin{matrix}Pt''\\ H_2\\ H_2\\ H_2\end{matrix}\right\}N_2Cl_2}_{\text{Chloride of platosonium. (Magnus' green compound.)}}$$

And this comparison is legitimate, for just as chloride of ethylene-diammonium is formed by the direct addition of chloride of ethylene to two molecules of ammonia, so Magnus' green compound is formed by the direct addition of platinous chloride, $Pt''Cl_2$, to two molecules of ammonia.

We do not know platinic bases strictly comparable with oxyethylenamine. There exist, however, oxyplatinic bases, and we know an oxyplatammonium in which the group $(PtO)''$ plays the part of a diatomic radical.

$$\underbrace{\left.\begin{matrix}PtO''\\ H_2\\ H_2\\ H_2\end{matrix}\right\}N_2Cl_2}_{\text{Chloride of oxyplatammonium (Gerhardt).}}$$

We might, perhaps, compare oxyethylenamine with the remarkable base discovered some years ago by Millon, which results from the addition of mercuric oxide to ammonia, just as oxyethylenamine results from the addition of oxide of ethylene to ammonia. But we will not pursue this subject further.

In all the compounds which we have considered, and which belong to the condensed types, the part of the polyatomic elements of mineral chemistry is exactly comparable with the part of the compound radicals of organic chemistry. These elements and these radicals possess the power of consolidating several molecules encroaching, so to say, upon each of them. If in two molecules of water

$$\left.\begin{matrix}H\\H\end{matrix}\right\}O \qquad \left.\begin{matrix}H\\H\end{matrix}\right\}O$$

we substitute the radical $(C_2H_4)''$ for H_2, there is formed the compound

$$\left\{\begin{matrix}\left.\begin{matrix}H\end{matrix}\right\}O\\ C_2H_4\\ \left.\begin{matrix}H\end{matrix}\right\}O\end{matrix}\right.$$

This radical, since it is indivisible, takes the place of two atoms of hydrogen, and there binds together the remaining atoms so as to form a single complex molecule. In hydrate of copper the same thing takes place: the indivisible atom of copper is substituted for H in each molecule of water and consolidates the remainder.

$$\left\{\begin{matrix}\left.\begin{matrix}H\end{matrix}\right\}O\\ Cu''\\ \left.\begin{matrix}H\end{matrix}\right\}O\end{matrix}\right.$$

The diatomic radicals play the same part in condensed ammonias. Thus two molecules of ammonia

$$\left.\begin{matrix}H\\H\\H\end{matrix}\right\}N \qquad \left.\begin{matrix}H\\H\\H\end{matrix}\right\}N$$

are welded together by the substitution of $(C_2H_4)''$ for H in each of them, thus forming—

$$\left\{\begin{matrix}\left.\begin{matrix}H\\H\end{matrix}\right\}N\\ (C_2H_4)''\\ \left.\begin{matrix}H\\H\end{matrix}\right\}N\end{matrix}\right.$$

that is to say, ethylene-diamine. The two ammoniacal residues are riveted together by the indivisible diatomic radical $(C_2H_4)''$.

We conceive the same of the part of platinum in platosamine—

$$\begin{matrix}\left.\begin{matrix}H\\H\end{matrix}\right\}N\\ Pt''\\ \left.\begin{matrix}H\\H\end{matrix}\right\}N\end{matrix}$$

We shall return to these considerations by-and-by; but we should give but an incomplete idea of the theory of types if we did not add that elements and polyatomic radicals may also consolidate or weld together different molecules: one molecule of hydrochloric acid, one molecule of water, and one molecule of ammonia, for example. This is the principle of the *mixed types* introduced by Dr. Odling, about which we proceed to say a few words.

By acting on glycol with hydrochloric acid, I have obtained a compound which I have called monochlorhydric glycol. It contains C_2H_5ClO, and we may express its composition by the formula—

$$\left.\begin{matrix}(C_2H_4)''\\H\end{matrix}\right\}\begin{matrix}Cl\\O\end{matrix}$$

and so bring it under the mixed type—

$$\left\{\begin{matrix}H\,Cl\\H_2O\end{matrix}\right.$$

We see here the part of the diatomic radical ethylene. It is substituted for H in the molecule of hydrochloric acid, and for H in the molecule of water, and encroaching upon both these molecules, it welds one to the other, because it is itself indivisible.

By analogous formulæ we may represent the monochlorhydrine and dichlorhydrine which Berthelot has obtained by making hydrochloric acid react upon glycerine. The following formulæ, which express the composition of these bodies, indicate at the same time with sufficient exactness the part of the triatomic radical glyceryle $(C_3H_5)'''$:—

Mixed types.

$$HCl \qquad \left.\begin{matrix}H_2\\H_2\end{matrix}\right\}O_2 \qquad\qquad \underbrace{\left.\begin{matrix}(C_3H_5)'''\\H_2\end{matrix}\right\}\begin{matrix}Cl\\O_2\end{matrix}}_{\text{Monochlorhydrine.}}$$

$$H_2Cl_2 \qquad \left.\begin{matrix}H\\H\end{matrix}\right\}O \qquad\qquad \underbrace{\left.\begin{matrix}(C_3H_5)''\\H\end{matrix}\right\}\begin{matrix}Cl_2\\O\end{matrix}}_{\text{Dichlorhydrine.}}$$

Lastly, we may represent the constitution of oxamic acid by the formula—

$$\begin{matrix}\left.\begin{matrix}H\\(C_2O_2)''\end{matrix}\right\}O\\ \left.\begin{matrix}H\\H\end{matrix}\right\}N\end{matrix}$$

in which we see the diatomic radical oxalyle C_2O_2 weld together a molecule of water and a molecule of ammonia in the type—

$$\begin{matrix}\left.\begin{matrix}H\\H\end{matrix}\right\}O\\ \left.\begin{matrix}H\\H\\H\end{matrix}\right\}N\end{matrix}$$

But the elements and the polyatomic radicals possess still another remarkable property: they are capable of accumulating in the complex compounds of mineral and organic chemistry. We shall enlarge upon this in the next lecture.

ACADEMY OF SCIENCES.

November 21.

A VERY interesting communication on vegetable physiology was read by M. Naudin. It was entitled "*On Hybridity considered as a Cause of Variability in Vegetables.*" The experiments and the results detailed merit the particular attention of botanists and horticulturists. The general result, however, appears to be what has been before observed, namely, that whatever variations may be produced, no permanently new species are obtained by crossing the plants.

M. Burdin read a paper "*On Heated Air as a Substitute for Steam as a Motive Power.*" A few weeks ago the author announced to the Academy that he had come to Paris expressly to replace steam with heated air in locomotives, boats, &c. To-day he made it quite clear upon paper that with his machine he could produce all the force with a much smaller expenditure of fuel. It is not said whether his machine is in existence or not.

France must once have been a very thickly-populated country. M. Bourdain has discovered *Two New Deposits of Flint Implements*—one in Paris itself, and the other an hour's distance. The gravel in the squares, promenades, and gardens of the city, the author says, contain archeological treasures—a prodigious quantity of arrow-heads and such like.

M. Jodin presented a note "*On the Chemical Action of Light on some Immediate Vegetable Principles.*" Everybody knows that, under the influence of light, tannin, chlorophyll, and other vegetable matters absorb oxygen and give off carbonic acid, and will not do so in the dark. The author repeats this statement.

M. Berthelot presented another note "*On the Decomposition of Formic Acid.*" We announced last week that the author could decompose formic acid into either carbonic oxide and water, or into carbonic acid and hydrogen. The difference in the decomposition, it seems, depends on the completeness of the process. If only a portion of the formic acid be decomposed, carbonic oxide and water result; but if all the acid is broken up, carbonic acid and hydrogen result. The first decomposition represents the initial effects of the heat, and takes place in an excess of acid. The second represents the final effect, and takes place when the whole of the acid disappears. The decompositions are effected by a longer or shorter exposure to the heat. In the first case the acid was kept at 260° C. for eight hours; in the second, the exposure to a like temperature lasted twenty-five hours. A short exposure to 300° of heat effected no decomposition. The author dwells on the influence of time, and remarks that the same is observed in the formation of the acid. The calorific phenomena observed during the decomposition will be referred to in another paper.

M. Fleury, in a note "*On the Heat of the Combustion of Formic Acid,*" seeks to explain the anomaly remarked by M. Berthelot. M. Fleury observed very truly that there is nothing to prove that in the formation of formic acid from carbonic oxide and water, the carbon in the CO does not separate from the oxygen before it combines to form the indivisible group $C_2H_2O_4$. On the contrary, he says, the unitary theory repudiates the notion of the persistence of the simpler molecular groups in the more complex groups which they go to make up. Here, then, in this decomposition of carbonic oxide is the "negative work," which, according to M. Berthelot, causes the absorption of heat, the disengagement of which in the combustion of formic acid so puzzles him. The intervention of time, M. Fleury says, explains nothing, for the time a phenomenon takes to accomplish has no relation to the heat necessary to produce it.

NOTICES OF BOOKS.

A Manual of Chemical Analysis, Qualitative and Quantitative. For the use of Students. Part II.—Quantitative. By H. M. Noad, Ph.D., F.R.S., &c. London: Lovell Reeve and Co. 1864.

Dr. Noad's "Manual" is a well-known book; and, although there is no announcement to the effect on the title-page, every middle-aged chemist will see at once that this is the earlier work in another form. But it is now many years since that work was published, and in the interval chemical analysis has made great progress. Many old and imperfect processes have been discarded, and new and better methods introduced. It is no mean praise to say that Dr. Noad is an industrious reader as well as an expert analyst, and has brought his book well up to the times by inserting every process of value which has been published up to a very recent date. We might especially point to the methods for estimating phosphoric and nitric acids as illustrating the truth of this remark, since in these we find all the best recently introduced methods fully described. We have no space for long quotations; but we come upon one passage which we extract, because it will serve to answer the question of a correspondent who addressed our readers a few weeks ago wanting a process for the detection of sulphur in hops. Here is one:—"By this test (nitro-prusside of sodium) the presence of sulphur in hops, wines, silk, &c., is easily detected. The substance under examination is placed in a flask with a piece of sheet zinc, diluted hydrochloric acid is poured over it, and the gas conducted into the solution of nitro-prusside. If the gas contain but a minim of sulphuretted hydrogen, the first bubble causes a violet cloud in the solution: after passing the gas for a short time it assumes the magnificent colour of a solution of permanganate of potassa. The vapour of hydrochloric acid passing over with the gas may be arrested by filtering it through cotton wool, though it does not affect the reaction unless it be continued too long."

Annales de Chimie et de Physique. October, 1864.

(*Continued from page 260.*)

The remainder of M. Wurtz's paper is devoted to the *diallylic compounds* and *hexylic glycol*, an isomer of dihydrate of diallyle. The paper will be found of great interest to those who make this kind of chemistry their study.

The only other paper in the *Annales* is M. Peligot's "*Researches on the Organic Matters Contained in Waters.*" The author, in the course of his examination of the water of the Seine, remarked that the precipitate produced by nitrate of silver always contained a certain proportion of organic matter. It became black when heated, and gave off ammoniacal vapours. When nitrate of lead was substituted for the nitrate of silver, the presence of the organic matter was still more clearly indicated. The precipitate, when heated, gave off an empyreumatic odour resembling that from burning wool. Most metallic salts he found to carry down the organic matter, but the most decided precipitant was perchloride of iron, which quickly occasioned the formation of ochre-coloured flocculi composed of ferric hydrate and organic matter. The author here remarks that the action of the perchloride of iron on many organic matters in water is prompt and most remarkable. He says it is an energetic and very efficacious disinfectant, which instantly removes from marshy and putrid waters their characteristic odour.

In the course of his investigations, M. Peligot discovered an easy method of separating the greater part, if not the whole, of the organic matter, at all events, that which is susceptible of combining with a metallic oxide. The process will, perhaps, be useful to some who may desire to estimate crenic and apocrenic acid, for the author's analysis of the organic matter separated closely corresponds with Mulder's analysis of apocrenic acid.

The precipitate produced in Seine water by nitrate of lead was found to be composed of carbonate, sulphate, and subnitrate of lead, together with the organic matter in combination with oxide of lead. A slight excess of very dilute nitric acid will dissolve from this mixed precipitate all but the sulphate. By adding to the solution obtained milk of lime, subnitrate of lead is precipitated, and also the compound of organic matter and oxide. Boiling water dissolves the subnitrate, and thus isolates the organic compound. This is a yellowish matter, which must be well washed on a filter to remove all excess of lead, and then dried over quicklime, and lastly at 110°. The specimen analysed by the author was composed of 65·7 oxide of lead, and 34·3 of organic matter. The organic matter had the following composition:—

Carbon	53·1
Hydrogen	2·7
Nitrogen	2·4
Oxygen	41·8
	100·0

Mulder, in his analysis of apocrenate of copper, obtained the following numbers:—

Carbon	51·8
Hydrogen	3·7
Nitrogen	3·3
Oxygen	41·2
	100·0

The remainder of M. Peligot's observations apply only to French waters, and have no general interest.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2538. Richard Wright, Barge Yard, Bucklersbury, London, "Improvements in preparing saccharine matters."—Petition recorded October 14, 1864.

2607. Arthur Reynolds, Bagillt, Flintshire, "Improved mode of manufacturing sulphuric acid."

2614. George Edmund Donisthorpe, Leeds, Yorkshire, "Improvements in obtaining grease from wash waters."—Petitions recorded October 21, 1864.

2675. Alexander Parkes, Birmingham, in the county of Warwick, "Improvements in manufacturing compounds of gun-cotton, and other vegetable substances similarly prepared, also in the preparation of castor and cotton oils and gum ballata, to be used with or separate from such compounds."—Petition recorded October 28, 1864.

2734. Frederick Yates, Birmingham, Warwickshire, "Improved apparatus for generating combustible gases."—Petition recorded November 4, 1864.

2776. Adolphe Moresu, Chancery Lane, Middlesex, "Improvements in extracting silver from lead." A communication from Don Francisco Marques Millandel Real, Rue Mautree, Bordeaux, France.—Petition recorded November 8, 1864.

Notices to Proceed.

1691. James Wilson, Exeter, Devonshire, and Walbrook, London, "Improvements in tanning, and in the machinery or apparatus employed therein."—Petition recorded July 7, 1864.

1695. Alfred Blake, Castle Brewery, Newport, Monmouthshire, "Improving water for the purpose of brewing, and beer produced therefrom."—Petition recorded July 8, 1864.

1727. Stephen Carey, East Ham, Essex, "Improvements in apparatus for calcining bones, and for re-burning and revivifying animal charcoal."

1729. Ludwig Schad, Cassel, Electorate of Hesse, at present residing at Warrington, Lancashire, "Improvements in the manufacture of pigments."—Petitions recorded July 12, 1864.

1744. Victor Pean and Alphonse François Le Gros, Rue de la Fidélité, Paris, France, "Certain improvements in coffins, and for preventing noxious emanations from dead bodies."—Petition recorded July 3, 1864.

1784. Amelie Angelina Bonnet, Rue de la Fidélité, Paris, France, "Certain improvements in the mode of preparing and applying chemical fumigations to the treatment of human diseases, and in apparatus connected therewith."—Partly a communication from her late husband (M. Leon Bornct), and partly invented by herself.—Petition recorded July 16, 1864.

1795. Frederick Seebohm, Düsseldorf, Prussia, and town and county of Newcastle-upon-Tyne, "Improvements in the manufacture of iron."—Petition recorded July 18, 1864.

1804. Henry Edward Francis De Brion, Welbeck Street, Cavendish Square, Middlesex, "An improved composition for protecting and preserving metals, such as iron, copper, and zinc, used in the construction of ships or in the protection of their sides and bottoms from oxidation and corrosion from the action of sea water, and for protecting from corrosion all submerged substances, such as chains, anchors, cables, and every oxidable metals submerged in water or exposed to atmospheric influences."—Petition recorded July 19, 1864.

1823. Alfred Vincent Newton, Chancery Lane, Middlesex, "Improvements in electro-telegraphic apparatus."—A communication from Royal House, New York, U.S.A.—Petition recorded July 21, 1864.

2347. Archibald Henry Plantagenet Stuart Wortley, Rosslyn House, Grove End Road, in the parish of St. Marylebone, and the Honourable William Warren Vernon, Rutland Gate, Hyde Park, both in Middlesex, "A new chemical process for producing photographic pictures, and in the preparation and manner of using the materials in such process."—A communication from Jacob Wothlij, Aix-la-Chapelle, Prussia.—Petition recorded September 24, 1864.

2460. Benedict Margulies, Trieste, Austria, but now residing at St. Helens, Lancashire, and John Knowles Leather, of the same place, "Improvements in the manufacture of salts of chromium."—Petition recorded October 6, 1864.

2661. John Stoho and William Pollock, Seven Bank Works, near Bonhill, in the county of Dumharton, N.B., "Improvements in tramping, wringing, and delivering yarns in connection with dyeing and bleaching processes."—Petition recorded October 27, 1864.

2668. John Charlton and Henry Charlton, Strangeways, Lancashire, and John Osborne Christian, F.C.S., Manchester, in the same county, "Certain improvements in sizing, dressing, filling, and stiffening yarns or fabrics composed of cotton, linen, silk, wool, or other fibrous materials or paper, whereby such materials are also rendered non-inflammable."—Petition recorded October 28, 1864.

CORRESPONDENCE.

Continental Science.

Paris, November 30.

Last week some experiments with an electric brake were made on the Strashurg railway. I have not been able to meet with a complete description of the apparatus, but it seems that a system of brakes attached to any number of carriages in a train is brought into operation by interrupting an electric current by means of a little apparatus attached to the tender, and thus under the control of the driver. When contact is made and the current is established again, the brakes cease to act. Connected with this is an arrangement by which the guard and even the passengers can communicate with the engine-driver. The experiments made showed that all the contrivances were perfectly effective, trains going at great speed being brought to rest at a distance of 250 to 300 metres, instead of from 1200 to 1500 as by the usual system of brakes. I should hope some arrangement of the sort will be adopted on all railways.

The part which electricity plays in the affair is evidently very small, but M. Dumas praised this application of a current very highly in his report to the Emperor on the allotment of the prize of 50,000 francs.

Signor Marini has come to Paris with his preparations, and anybody who wishes to be disgusted may see at the Hotel Mazarin a round table entirely made up of a sort of mosaic of petrified brain, blood, bile, &c. You must imagine the etceteras! He has some other things not so disgusting, but quite as useless—dried or mummified limbs, for instance—which, by injecting, he can make to look as if they came from a recently deceased body. If "subjects" were scarce the process might prove of some utility, but as it is I do not see what scientific purpose can be served. The process may have an interest for people of morbid tastes, like Dr. Martin Van Butchell, who, I think it was, kept his two dead wives in his bedroom. He married a third, who insisted on the interment of her rivals before she would go to the altar. But it may be objected that Signor Marini's process is a contravention of the laws of nature, which seem to have ordained that mortals shall eventually become manure; and the objection is the stronger in so far as it is only in the capacity of manure makers that a great many mortals ever do any good in the world.

Turning to more savoury matters, I may mention, for the sake of any lovers of Burgundy among your readers, that the jury which sits annually on this respectable beverage reports that this year's vintage is "particularly fine"—as, by the way, I have seen a certain F.C.S. report in print of a London tradesman's ducks' eggs. The produce (of Burgundy, not ducks' eggs) is rather smaller than usual, but the quality of both red and white wine is exceptionally good. It is a curious fact that the vine has never been affected by the oïdium in Burgundy.

A Doctor Girouard, of Chartres, has made the curious discovery that a vacuum can be produced by means of a current of air. If, for example, you have a vessel with a small aperture, and you blow a strong current of air across this aperture, you produce a vacuum in the interior of the vessel. You can render this evident in the following way: —Set an ordinary bell-glass, furnished with a stop-cock, on a dish of water, and, with a blow-pipe or glass tube, send a strong current of air across the mouth of the stop-cock. The current will be found to carry away with it air from the inside of the bell-glass, into which, accordingly, the water will rise. As another correspondent of *Les Mondes* remarks, this experiment may lead to new explanations of a number of meteorological phenomena, and the principle appears susceptible of utilisation.

I have mentioned before the evening classes opened at Mulhouse. We have now the numbers who have entered to attend them. They number nearly 700, out of which number 71 have joined the English class.

A varnish made of pitch dissolved in sulphide of carbon has been introduced here for preserving wood and metals. I have no doubt it is very useful, but I am sorry for the people who are obliged to apply it.

Among the papers read at the last meeting of the Academy of Sciences, of which I dare say you will only find the titles in the *Comptes Rendus*, I may mention one by M. Chassaing, who lays it down as a rule that a first-born daughter always strongly resembles her father. Newly-married men should make a note of this law.

On the Difference in Gases arising from Various Metals, &c., under Action of Heat.

To the Editor of the CHEMICAL NEWS.

SIR,—As this is a chemical question, and one that I have never met with in print, I would draw attention to it to elicit any information on the subject. I am at present going to try copper pipes (drawn, not brazed) heated to be the means of generating heat; and the air will be forced through by blow-fan to effect boiling of liquids beyond a certain density, and possibly for inflation of balloons. Copper is preferable to iron in many respects; it does not crack or rend; it is easily patched; and the gas from it will not flavour some things as sugar so much as iron. I shall be glad to hear comments and dissents to my plan.

I am, &c., C. M. K. DICK,
(late of Trinidad, sugar planter).

MISCELLANEOUS.

Royal Institution.—The general monthly meeting will take place on Monday, December 5, at 2 o'clock.

Pharmaceutical Society.—The next Pharmaceutical meeting will take place on Wednesday evening, December 7, at 8 o'clock. The chair will be taken at 8.30 precisely. The following papers will be read:—"On the Gamboge Tree of Siam," by Daniel Hanbury, F.L.S. "On the Extracts of Hop and Rhatany," by Mr. A. F. Haselden. "On Nitrite of Soda," by Mr. A. J. Roberts. At the Pharmaceutical meeting on Wednesday evening, January 4, a paper "On Perchloride of Iron and its Solutions, and the Various Processes for its Preparation," by J. Attfield, Ph.D., F.C.S.

The Wholesale and Export Drug Company (Limited).—A company with the above name has been projected, by taking shares in, and dealing with which, chemists and druggists may secure all the advantages of the co-operative system. The undertaking comes before the public recommended by the adhesion of a considerable number of chemists and druggists; and with the application of the Limited Liability Act to provide capital, and the principle of co-operation to secure connexion, we see no reason why, with good management, the shareholders should not realise a very handsome return, and we wish the chemists and druggists every success.

Photographs of Natural Colours.—M. Niepce de St. Victor is still pursuing his investigations on the above interesting subject. Some of his recent observations are of great importance. He makes use of baths of soluble chlorides to obtain a sensitive surface, and he has found that the chlorides which give coloured flames reproduce objects of the same colour as the flame. Chloride of strontium, for example, gives him a surface which reproduces the red colour of an object; and thus by using baths of variable composition, in which the chloride corresponding to the predominating colour is in the largest proportion, M. Niepce obtains representations of natural colours. They are not permanent, however. Chlorine, chloride of copper, and perchloride of iron appear, it is said, to be the best agents, and by varying the dose of the chlorine and chloride he obtains certain colours in a marked manner.

Serious Case of Poisoning.—An inquest was commenced at York on Monday respecting the death of Elizabeth Nuttall, wife of Henry Nuttall, a brass finisher, living near Oxford-street, London. Deceased was a native of York, and was visiting there at the time of her death for the benefit of her native air. For twelve or thirteen years she has been subject to palpitation of the heart, and during the whole of that time had taken morphia for its relief. Her husband had also from illness been addicted to morphia, taking as much as thirty grains a day; but believing that it did neither himself nor his wife good, he gradually broke off the habit. On Saturday afternoon Mrs. Nuttall sent to the shop of Mr. Hardman, druggist, of York, for five grains of morphia, and her daughter brought back with her a powder closely resembling it. Mrs. Nuttall at once took it in water, but instead of finding relief was attacked with what at first appeared to be spasms, but what subsequently, from the aching of the back, the clenching of the hands, and other symptoms, led to the belief that she was labouring under the influence of strychnia. She died in half an hour from the time of taking the powder. Deceased's daughter said her mother, before taking the powder, remarked that it swam on the surface of the water, instead of sinking to the bottom as usual. She was served with the powder by a Christopher Powell, who had not assisted her before. At the time the daughter went for the poison, Mr. Hardman was absent, and the bottle from whence the poison was served was in a drawer with other poisons, one of which was strychnia. Powell is a porter in Mr. Hardman's establishment, can read labels, and had frequently served various other articles before. The jury adjourned the inquest for the purposes of a post-mortem examination and analysis of the contents of the stomach. This looks like another result of keeping strychnia in powder instead of crystals.

ANSWERS TO CORRESPONDENTS.

J. W.—Apply to Williams and Norgate.

E. J. Mills.—Received with thanks. The suggestion will most certainly be attended to.

W. E. S. W., Rochester.—See the appendix to the last edition of Fownes's Chemistry and Wurtz's lectures in the CHEMICAL NEWS.

E. J.—Dilute chloride of palladium does not give a precipitate in a concentrated solution of iodide of potassium. The protonitrate of palladium should be used.

LONDON SEWAGE.

This production, which was described by Mr. Tite at the late meeting of the British Association as the achievement of "Mr. Chadwick and the wisest men," has already been a source of great discomfort and trouble, and seems to promise further results of a similar kind. Indeed, the difficulties of dealing with sewage appear to be only just coming into view, and to be far greater than were anticipated. The Metropolitan Board of Works had only just taken in hand to oppose its invasion of the Thames by means of their intercepting sewers, as Mrs. Partington opposed the Atlantic with her mop, when the towns in the higher parts of the Thames valley, naturally following the precepts and example of the "wisest men," sought to dispose of their refuse as sewage, a course which involved the possible contingency of supplying London coffee-pots with the proceeds of Oxford slop-pails, and rendering the Thames as foul from another source as it once was from receiving the refuse of London.

There are many who have grave doubts as to the "water carriage" system adopted in London for getting rid of the town refuse, being the best means of effecting that object even when considered only as a matter of sanitary economy. But in that respect it is at least efficient so far as the condition of dwellings is concerned, and in the case of London it has been adopted to such an extent, that any change may now be regarded as impracticable. When the intercepting sewers are completed, and the sewage of London can be entirely discharged into the Thames at a distance from London, it may be reasonably be hoped that, by means of the large outlay which has been incurred, it will have been placed beyond the possibility of being a further source of annoyance, and that there will neither be a reflux of it up the river, nor a pestilence at the place where it is discharged.

But these considerations relate merely to the getting rid of the sewage, which it is the business of the inhabitants of London to do and to pay for being done. There is, however, another aspect of this material, in which it deserves further consideration: it is the agricultural value of certain ingredients of sewage. These are chiefly phosphoric acid, potash, and ammonia. Of these substances, the first and last named are the most important constituents of artificial manures which are necessary, under the existing agricultural system, for obtaining a sufficiently large amount of produce from land.

Phosphoric acid—probably the most valuable of all in this respect—is imported into this country for use as manure to an enormous extent, probably equivalent to more than 100,000 tons of phosphates annually. Ammonia and potash are also imported and used for the same purpose, either directly or for the most part in the state of cattle food.

By these means the exhaustion of land, of which there has been so much idle talk, is not only prevented, but is probably more than compensated for, especially in the case of the better managed farms, which are becoming now the rule rather than the exception.

But still there is a waste of material possessing value as manure, which results from the mode in which the refuse of towns is disposed of. If it be assumed that in the case of land farmed on the most approved system, there is sold off each acre in the course of four years, thirty bushels of wheat, thirty-five bushels of barley, and the meat produced from ten tons of turnips, two tons of hay, besides imported cattle food, then there would be removed in the produce exported per acre every year, about eight pounds of phosphoric acid and five pounds of potash. The produce containing these substances, being consumed as food in towns, they pass into the excretal refuse, and, where the water carriage system is adopted, into the sewage.

The aggregate value of these ingredients of sewage will therefore be very considerable in the case of London, and proportionate to the quantity of corn, meat, &c., consumed as food by the population. It would be somewhat hazardous to express in figures the value of these ingredients, but if the value of the quantities of phosphoric acid, ammonia, and potash amount to 6s. per head per annum it would be very considerable. It is therefore very desirable that attention should be directed to the means by which this material may be made useful in contributing towards the production of corn and meat, equivalent to that from which it has been derived.

The attempt to effect this object by precipitating the sewage with lime, &c., which was in favour some years ago, and which was so obstinately persisted in with such a total disregard of known facts, and notwithstanding its palpable absurdity, is now tolerably well forgotten, and the results which have been obtained by applying sewage to waste land, as, for instance, at Edinburgh, have been in certain respects so advantageous, that after having been disregarded and even denied for some time, they have at length been the means of inspiring a belief in the possibility of realising great profits from such an application of sewage. Under the influence of such a belief, and with a convenient absence of any sound acquaintance with the subject of manuring, or of the value of various ingredients of manure, and of the conditions under which they are useful, the idea has become prevalent that sewage ought to be a source of profit as a saleable commodity, instead of involving outlay in getting rid of it.

Such an idea, though grateful enough to vestries and ratepayers, has a very dubious foundation, and though it doubtless possesses the qualifications for being made up into an attractive form as the stock in trade of a "limited" company, it is so far from being a trustworthy basis of speculation, that we consider it worth while to examine, from a chemical point of view, more in detail the proposals and the probabilities of the several schemes which have been put forward with the view of "making London sewage pay," a project which now enjoys the conjoint patronage of Lord Robert Montague, the Common Council of the City of London, Dr. Brady, Baron Liebig, and Mr. Mechi.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Solubility of Gold in Acids,

by Arthur Reynolds, *B.Sc.*

Some time ago I communicated to the Chemical News some remarks on the solubility of gold in a mixture of sulphuric and nitric acids. I have since made some more experiments on this point.

A solution of chloride of gold, when heated in the same manner with sulphuric acid, forms a solution similar to that of gold in a mixture of sulphuric and nitric acids. It is precipitated by water. The solution, whether formed by heating gold with nitric and sulphuric acids or by heating chloride with sulphuric acid, gives a deposit of metallic gold on continuing the heat and when all the nitric acid is driven off the whole of the gold is deposited.

Nitric acid in excess prevents the precipitation by water, but the gold dissolves better when the sulphuric acid has a little water with it and only a small quantity of nitric acid.

Contributions to the History of Thallium,

by G. WERTHER.

I SHALL, for the present, only give the results of my further inquiries into the combinations of thallium, with reference to the proto-salts, but hope later to bring to a somewhat satisfactory conclusion the apparently scanty information which analysis has yielded concerning the per-salts.

The fact of the isomorphism of oxide of thallium with potash, which I have established by means of its double sulphate with magnesia, leaves no doubt that we must, with R. Böttger and Dumas, place thallium by the side of potash in the systematic arrangement of undecomposed bodies, and not, as Crookes and Miller think, with lead and silver. I have followed up this isomorphism through several double sulphates as well as double salts of selenic acid, and finally with salts which contained potash and oxide of thallium on the one hand, and magnesia oxide of zinc and oxide of copper united with selenic acid on the other. All these isomorphous double salts showed a preponderance of the crystalline form of the double sulphate of zinc and thallium already described, but were distinguished from the corresponding order of seleniates by the constant absence of $2r'$, as well as by other phenomena which caused me subsequently to inquire into the influence which the introduction of different metallic oxides into an isomorphous group mixture produced in their crystalline form. I remarked, by the way, that the double seleniate of zinc and thallium—$ZnOSeO_3 + TlOSeO_3 + 6HO$, gave, upon measurement, the following result:—

$$\left.\begin{array}{l} c : p = 102°50' \\ p : p = 71°12' \\ c : q = 154°9' \end{array}\right\} \begin{array}{l} \qquad o = 74°9' \\ \text{hence} \\ a : b : c = 0·7442 : 1 : 0·5036. \end{array}$$

This salt resembles, throughout, the corresponding sulphate, but is difficultly soluble in water. I have also tried to follow up the isomorphism through other simple salts of thallium, and have chosen for that purpose the hyposulphate which, according to former experiments, easily crystallises.

Hyposulphate of thallium, $TlOS_2O_5$, crystallises in an anhydrous state like the corresponding potash salt; is readily soluble in water, and is deposited upon quick evaporation in agglomerated, tabular crystals, and by slow evaporation over sulphuric acid in single, glassy crystals. I have, however, obtained none which permitted sufficiently accurate measurement. But, in spite of the outward difference in the form of hyposulphate of potash, its isomorphism appears not improbable to me, except that crystals of salts of thallium are hemimorphous and hemihedric. By the employment of a somewhat greater quantity of salt I hope to get more definite crystals.

I tried to prepare a double salt of thallium with hyposulphates of nickel, in order to test, by experiment, the newly-raised question upon the existence or non-existence of double salts of hyposulphuric acid. In fact, by spontaneous evaporation of a very concentrated solution of both salts, we get long shining needles matted together like felt. Notwithstanding their invariably different appearance, there seems to be no definite combination, for the amount of nickel contained in them is too insignificant.

I estimated the loss which the hyposulphate of thallium suffered when heated from 100°—110° to a faint red heat. The first loss, at 110°, was only 0·003 upon 0·535 grm. of substance, and was hygroscopic water. The loss at a red heat was 0·062 = 11·7 per cent. The calculation required 11·3 per cent.

Carbonate of Oxide of Thallium.—Although this salt has already been sufficiently analysed and described by Crookes and Lamy, yet I have made it the object of my inquiries, principally in order to ascertain whether, by any means, a bicarbonate may be produced to which may be attributed the peculiar behaviour towards turmeric paper observed by Erdmann.

All attempts to obtain a bicarbonate in a solid form have been fruitless. I have treated the hot and concentrated solution of the metal oxidised in the air with a stream of washed carbonic acid, so that during its cooling a quantity of crystalline needles appeared. (I.) These were the simple carbonate. Then the salt from the mother liquor, which was neutral to turmeric paper, was obtained, once by precipitation with spirits of wine; (II.) another time it was slowly evaporated under the air-pump, when crystals in the form of long broad leaves were deposited; (III.) and a third time the crystals were freed by weak pressure from the remaining solution of the carbonate. (IV.) The crystals immediately became simple carbonate, which, upon decomposition in the carbonic apparatus, gave the following results:—

	Grm.					
I.	0·9885	lost	0·093 CO_2	= 9·4 p.c.		$TlOCO_2$ contains 9·4 p.c. of CO_2.
II.	1·54	,,	0·152 ,,	= 9·87 ,,		
III.	1·21	,,	0·1125 ,,	= 9·29 ,,		
IV.	0·552	,,	0·056 ,,	= 10·14 ,,		

(This is on the supposition that the atomic weight Tl = 204, although I have already mentioned that it must be placed lower, perhaps at 203·5 or 203·7.)

Finally I tried to prove the presence of a bicarbonate existing in solution through the analysis of a neutral solution which did not react upon turmeric paper. When, however, in order to remove the remaining free carbonic acid, I first traversed the solution with a stream of cold air, it was no longer indifferent neutral to turmeric paper, but browned it. In short, it is possible to infer the existence of a bicarbonate from the reaction with turmeric, but it does not admit of proof; for the bicarbonate, if it exist, is very easily decomposed. A very small quantity of weak alcohol will do it, or perhaps, plenty of water alone. When, for instance, we place the aqueous solution of the salt treated with a considerable excess of carbonic acid which is neutral to turmeric paper, with an alcoholic solution of turmeric, no change of colour is at first observable, but browning soon commences, continues for days, and, as far as I have observed, it only begins to grow pale after five or six days. The turmeric paper wetted with solution of carbonate which remains yellow becomes brown when quickly dried. Erdmann observed that exposure to the air produced the same effect. By subsequent treatment with carbonic acid it again becomes yellow, then, if boiled in water, brown again, and so forth. But the appearances are totally different as regards turmeric when treated with a solution of oxide of thallium or of the carbonate mixed with it (having such an alkaline reaction). If we mark with this liquid upon turmeric paper and moisten the spots, they brown immediately, but pale again shortly. If we moisten the places which have grown dry the brown colour reappears, but sometimes not, and seldom after a second drying. Turmeric paper thoroughly soaked with a solution of oxide of thallium behaves in the same manner. If we hold a paper, bleached as above, over ammonia, or soak it in solution of carbonate of soda no brown colour reappears. In a word, the turmeric dye is destroyed. I sought to explain this phenomenon by the assumption that, as oxide of thallium is easily changed to peroxide of thallium in the open air—more easily than we generally suppose—the oxygen becomes ozonised during this peroxidation, and destroys the colouring matter. But I have never succeeded, even with the closest observation of the process, in detecting the supposed peroxide, for when a bleached turmeric paper is heated with weak sulphuric acid nothing but protoxide of thallium can be detected in the solution by iodide of potassium. If we accept this hypothesis we must adopt the, not improbable, supposition that immediately after its production, whether through a part of the ozone or of the peroxide of hydrogen originating from it, or whether through the organic matter present, the oxide is reduced. It does not to me appear necessary to adopt this explanation, for oxide of thallium in solution likewise destroys turmeric. For instance, if we mix a solution of oxide of thallium with an alcoholic solution of this dye, browning commences, but after a few minutes it grows pale, and then the yellow colour can be induced in the residue by weak acid, or the original brown colour can be restored by alkali.

Concerning the properties of carbonate of oxide of thallium observed by Lamy, I have corroborated Crookes' (*Journ. Chem. Soc.*, April, 1864) observation that a solution super-saturated with carbonic acid leaves behind by evaporation in the water bath a perfectly white crystallised salt, and that no yellowish brown particles are found among them. If, however, the solution contains some hydrated oxide the same solution changes by evaporation into brown oxide. When heated the salt partially decomposes and melts to a gray mass, according to Lamy, or, as I have found, for the most part, to a brownish mass. But we are surprised that Lamy should have troubled himself to define the specific gravity of this mass, as it always contains portions more or less considerable of brown oxide. It is only soluble to a small extent in water, and the solution in acids plainly shows the existence of peroxide when treated with reagents (ammonia, iodide of potassium, etc.).—*Journ. fur Prakt. Chemie*, xcii., 351.

On Tasmanite, a New Mineral of Organic Origin, by A. H. CHURCH, *M.A., Professor of Chemistry, R.A. College, Cirencester.*

THIS mineral occurs in a laminated shale from the river Mersey, north side of Tasmania. It was exhibited in 1862 as "resiniferous shale" by the Dysodile Company in the Tasmanian Court of the International Exhibition. The shale contains from 30 to 40 per cent. of a yellowish brown combustible matter, which occurs in small discs, marked with a few ridges.* These discs may be separated from the inorganic portion of the mineral by crushing it to a coarse powder, and pouring strong hydrochloric acid over it, when the discs become liberated, and float to the surface of the liquid, the density of which should have been increased by the addition of chloride of calcium to it. The organic mineral thus separated is repeatedly washed with water and then dried at 100°; it still contains from 8 to 12 per cent. of inorganic impurities, chiefly a silicate of alumina.

The density of the discs is about 1·18; hardness 2; fracture conchoidal; and lustre resinous. They are unaffected by hydrochloric acid, carbonised with evolution of much sulphurous anhydride by sulphuric acid, while nitric acid slowly oxidises them. They are insoluble in alkalies, and in ether, bisulphide of carbon, turpentine, alcohol, benzole, and other similar liquids. Submitted to destructive distillation, tasmanite (the name given to the new mineral) gives oily and solid products, the odour of which recalls that of some specimens of Canadian petroleum.

The most characteristic point in the composition of the mineral is the great amount of sulphur it contains—not in combination with a metal, as in pyritic coal, but in intimate union with the carbon and hydrogen of the organic matter itself. The analysis of the mineral led to the following results, when allowance was made for the ash:—

Carbon	79·34
Hydrogen	10·41
Sulphur	5·32
Oxygen	4·93
	100·00

These numbers accord well with the expression—

$$\bar{\mathrm{C}}_{40}\mathrm{H}_{62}\bar{\mathrm{O}}_{2}\mathrm{S},$$

as may be thus seen:—

	Experiment.	Theory. $\bar{\mathrm{C}}_{40}\mathrm{H}_{62}\bar{\mathrm{O}}_{2}\mathrm{S}$.
Carbon . . .	79·34	79·20
Hydrogen . .	10·41	10·24
Sulphur. . .	5·32	5·28
Oxygen. . .	4·94	5·28
	100·00	100·00

Tasmanite may be viewed as the sulphide of an oxidised radical homologous with benzoyle—

$$\bar{\mathrm{C}}_{7}\mathrm{H}_{5}\bar{\mathrm{O}} + 13\bar{\mathrm{C}}\mathrm{H}_{2} = \bar{\mathrm{C}}_{20}\mathrm{H}_{31}\bar{\mathrm{O}},$$

which may be regarded as the radical of tasmanite (and of retinite too, to which the formula $\bar{\mathrm{C}}_{40}\mathrm{H}_{62}\bar{\mathrm{O}}_{4}$ has been before assigned):—

$$\left.\begin{matrix}\bar{\mathrm{C}}_{20}\mathrm{H}_{31}\bar{\mathrm{O}}\\ \bar{\mathrm{C}}_{20}\mathrm{H}_{31}\bar{\mathrm{O}}\end{matrix}\right\}\mathrm{S} \quad \text{Tasmanite.}$$

$$\left.\begin{matrix}\bar{\mathrm{C}}_{7}\mathrm{H}_{5}\bar{\mathrm{O}}\\ \bar{\mathrm{C}}_{7}\mathrm{H}_{5}\bar{\mathrm{O}}\end{matrix}\right\}\mathrm{S} \quad \text{Sulphide of benzoyle.}$$

Tasmanite and retinite may be derived from a turpentine—$\bar{\mathrm{C}}_{40}\mathrm{H}_{64}$.

Notes on the Platinum Metals and their Separation from Each Other, by M. C. LEA, *Philadelphia.*

PART I.†

FEW branches of inorganic chemistry present difficulties comparable with those involved in the study and separation of the platinum metals. Their close analogy with each other, and the remarkable manner in which the relation of each to chemical reagents are controlled by the presence of the others, give rise to difficulties in their detection and separation, which are only by degrees being surmounted. Much time and unwearied labour on the part of the chemist are required to reach results, which, when obtained, appear insignificant in proportion to the effort which they cost, and it may, in fact, be said that the platinum metals constitute a chemistry in themselves, governed by special rules, and to be studied by special methods: each step in the simplification of the

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* Figures of these discs, and full analytical details, will be found in *Phil. Mag.* for December.

† *Am. Journ. Science and Arts*, No. 112, Vol. xxxviii.

TECHNICAL CHEMISTRY.

The Preparation of Matches free from Phosphorus.

Hierpe has published* the following receipts for a composition for the heads of matches, and for an igniting surface. That for the matches is as under:—

Chlorate of potash	4 to 6 parts.
Bichromate of potash . . .	2 ,,
Ferric oxide	2 ,,
Strong glue	3 ,,

Oxide of iron may be replaced by oxide of lead or of manganese. The above preparation will not ignite on sandpaper, but requires a surface specially prepared for it, and the author employs the following on the boxes:

Sulphide of antimony . . .	20 parts.
Bichromate of potash . . .	2 to 4 ,,
Oxide of iron, lead, or manganese .	4 to 6 ,,
Glass powder.	2 ,,
Strong glue or gum . . .	2 to 3 ,,

Another composition is described by Dr. H. Poltzer.† A solution of sulphate of copper is divided into two equal parts—one is supersaturated with ammonia, the other with hyposulphite of soda. The two solutions are now mixed, and the mixture is briskly stirred. A violet-coloured powder now deposits, which is a compound, says the author, of hyposulphurous acid with oxide and suboxide of copper, soda, and ammonia. A mixture of this salt with chlorate of potash detonates when struck with a hammer, and when rubbed in a mortar ignites and burns like gunpowder, leaving a black residue.

The above salt the author proposes to use for matches. It is not soluble in water, and the mixture with chlorate of potash is not hygroscopic. The mixture may be made with moist chlorate, and the gum solution, and can be safely dried at 50°C. or higher. It inflames when rubbed on a rough surface, and the temperature developed is sufficiently high to ignite sulphur on the stick.

The only difficulty the author finds is in making the mass coherent: when dried on the stick he found that it would crack and drop off when rubbed. A manufacturer will probably soon overcome this difficulty.

The proportions made use of were one part of the copper salt, and two parts of chlorate mixed in a sieve, and then made into a mass with solution of gum, together with a little glass powder. This mixture was applied to matches dipped in sulphur as usual.

PHARMACY, TOXICOLOGY, &c.

Researches on Spots of Blood.—Determination of their Age, by M. Pfaff. *Their Origin, by M.* Erpenbeck.

Blood spots, as every one knows, are of a beautiful red colour, becoming brown with time. The red colour begins to change from the second day, the spot becomes visibly brown by the third day, and after a few months it is black, with a slight yellowish tinge.

To these well known characteristics M. Pfaff adds others more precise, drawn from the action exercised on these spots by a solution of arsenious acid (containing one grain to two grains of water). The limit set by him is the time taken by the spot to become pale in this solvent, or until its edges are barely distinguishable from the surrounding substance.

When new they dissolve in a few minutes.

When from	1—2 days old,	they require	¼	hour to dissolve.
,,	3—8 ,,	,,	¼—½	,,
,,	2—4 weeks	,,	1—2	,,
,,	4—6 months	,,	3—4	,,
,,	One year and upwards		4—8	,,

With the time taken in effecting the solution, the colour of the liquid obtained must be taken into consideration; the new spots giving a red solution, old ones a brown solution.

Chlorine may in this case be useful in the following manner:—

A spot four months old, for instance, requires to be left 3—4 hours in the arsenious liquid, to be reduced to a slight residue of fibrine, but with edges, still perfectly recognisable. By then leaving the spotted substance for an hour in chlorated water, the edges will become quite indistinct.

A spot six months old, having remained four hours in the arsenical liquid, requires two hours in the chlorated water to cause the edges to disappear.

Under the same condition, a spot eight months old requires three hours; a spot more than a year old requires more than five hours, and so on; the older the spots the longer time they require.

For determining the specific odour of blood, M. Erpenbeck believes he can advantageously substitute heat for sulphuric acid; in operating with fresh blood, he lets a few drops fall into a test tube, and heats it by means of a very small flame. The odour is developed directly all humidity is dispelled, and before the blood begins to carbonise; it is very evident during the cooling, and remains for several months in the sealed tube.

Dry blood he dissolves in water, or at least moistens it before exposing it to the action of heat.

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.

The anniversary meeting of the Royal Society was held on St. Andrew's Day, November 30; on which occasion the President, Major-General Sabine, delivered his usual annual address, and presented the medals awarded by the Society this year.

The Copley Medal was awarded to C. Darwin, Esq., F.R.S., for his important researches in geology, zoology, and vegetable physiology. This gentleman was prevented from attending by sickness.

The Royal Medal was presented to Warren de la Rue, Esq., for his observations on the total eclipse of the sun in 1860, and for his improvements in astronomical photography.

Another Royal Medal was presented to Mr. Jacob Lockhart Clarke for his researches on the intimate structure of the spinal cord and brain.

The Rumford Medal was presented to Professor John Tyndall, F.R.S., for his researches on the absorption and radiation of heat by gases and vapours.

We quote a portion of the learned President's address relating to Professor Tyndall's researches:—

"Previously to the researches of Professor Tyndall hardly anything had been done in the way of an experimental determination of the absorption of radiant heat by gases and vapours. Melloni had inferred from his experiments that atmospheric air is sensibly diathermanous in a length such as that of an ordinary room, while Dr. Franz came to the conclusion that a column of air only three feet long absorbed more than three and a-half per cent. of the heat-rays from an argand lamp. The discrepancy of these results gives some view of the difficulty of the experiments; but it is only by the perusal of the earlier part of

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* *Polytech. Centralblatt*, 1864, p. 696.

† *Ibid.*, 1863, p. 1642.

Professor Tyndall's first memoir on the subject that the skill and patience can be appreciated with which the various sources of error were one by one detected and eliminated by him."

After referring to Professor Tyndall's memoirs, General Sabine remarked :—

"It may serve to show the difficulties which beset the inquiry, arising from the interference of disturbing causes, to state that two such experienced physicists as Professor Tyndall and Professor Magnus of Berlin should have arrived at, and long maintained, opposite conclusions respecting the absorption of radiant heat by air, and the influence of aqueous vapour. This led Professor Tyndall, in a third memoir, to consider more especially the case of aqueous vapour, which he had already treated in his two former papers. The result is that his conclusions have been so confirmed by a system of checks and counter-checks, and by the complete harmony which they present with what we know to be true in other cases, that it seems impossible to doubt their correctness.

"The conclusion that the chief absorbing action of the atmosphere on non-luminous heat is due to the aqueous vapour which it contains has numerous and important bearings on meteorology, and has been applied by Professor Tyndall to the explanation of some phenomena which appear hitherto to have been imperfectly understood.

"In a fifth memoir, which may be expected to be published in a few days, he examines, among other things, the penetrative power of the heat radiated from various flames, and shows that such heat is absorbed with especial facility by the gases which result from the combustion.

"Professor Tyndall concludes from his researches that, as a general rule, the opacity of a substance with respect to radiant heat from a source of comparatively low temperature increases with the chemical complexity of its molecule; and he has given some remarkable instances in which the law is found to be true. Whatever may be thought of our ability to explain the law in the present state of our knowledge respecting the molecular constitution of bodies, the law itself is in any case highly remarkable."

CHEMICAL SOCIETY.

Thursday, December 1.

Professor A. W. WILLIAMSON, Ph.D., F.R.S., *President, in the Chair.*

THE minutes of the previous meeting were read and confirmed, and several donations to the Society's library formally acknowledged. Mr. M. Carteighe, 172, New Bond Street, was admitted a Fellow of the Society, and the following gentlemen were balloted for and duly elected Fellows of the Society, viz. :—Clayton S. Beauchamp, Lieutenant Royal Engineers; Mr. John Bray, High Street, Sheerness; Mr. Charles Ekin, Bath; Mr. Henry Haywood, Broomhall Park, Sheffield; Lieutenant H. M. Hozier, 2nd Life Guards, Topographical Department, New Street, Spring Gardens; Mr. Daniel Harmer Jay, Frog Island, Leicester; Mr. Joseph F. Paine, M.A., Magdalen College, Oxford; Mr. J. G. F. Richardson, Manufacturing Chemist, Leicester, Mr. W. W. Rouch, Norfolk Street, Strand; Lieut.-Colonel H. Y. D. Scott, Royal Engineers, South Kensington Museum; Mr. J. Berger Spence, Newton Heath, near Manchester; Hermann Sprengel, Ph.D., Chemical Works, Kennington Common; and Mr. Alfred Phythian Turner, 3, Upper Baker Street, London. The names of Mr. Alfred Noble, Bristol, and Mr. J. Carter Bell, Manchester, were proposed for the first time, and that of Mr. Alexander Y. Stuart, Apothecaries' Hall, London, for the first time.

The PRESIDENT then announced the names of nine members who had allowed their subscriptions to the Society to lapse for a number of years, and whom it was now proposed by the Council to remove from the list of Fellows. He then called upon Professor Redwood to read from the bye-laws of the Society those which were applicable in such a case, and took the sense of the meeting as to whether the ballot should be taken separately or collectively. The latter course having been decided upon, the result of the ballot was favourable to the proposition made by the Council, and the nine members were accordingly struck off the list.

Dr. MARCET was then invited by the President to favour the Society with a further communication upon the same subject as that upon which he had addressed the Society at its last meeting. The paper was entitled a "*Note on the Distribution of Albumen through Muscular Tissue.*" Dr. Marcet commenced by recapitulating the conclusions which he advanced at the last meeting, and referred to Professor Graham's objection to his statement in regard to the diffusibility of albumen. Having made further experiments in the interim, and adopted certain suggestions offered by the great author of "Dialysis," he was now prepared to modify to some extent his original conclusions, and would at once proceed to describe the facts which he had recently ascertained. The delicate membrane which covers the sheep's liver could easily be detached by macerating the entire organ in water; this was then carefully cemented to the lower edge of the glass cylinder to form a dialyser, and on filling this with water for the purpose of testing its porosity, it was discovered that minute specks of liquid made themselves apparent after twenty minutes on the lower surface of the septum. At the end of four hours these had accumulated so as to form a drop, then a second, and the third drop fell one hour and a-half after the second. The natural membrane was therefore, to a slight extent, permeable by water. The dialyser was then charged with an aqueous extract of flesh, and left for seventeen hours immersed in water; at the expiration of this time it was found by analysis that 32 per cent. of the albumen in the fluid extract had passed through the diaphragm, and on comparing this with the actual diminution in the bulk of liquid, it was ascertained that the amounts of water and albumen were directly proportional, or, in other words, that the albumen and water had passed through in equal degrees, and hence the passage of albumen must be attributed to the existence of sensible apertures, or pores, through which the entire liquid diffuses itself mechanically. The whole liver and sections of the organ were then employed as dialysers, and gave results generally in accordance with the foregoing, but less albumen diffused through, and the perfect organ was found to be four times more efficacious than the prepared section of liver. Reviewing the whole of the facts, the author was compelled to adopt the conclusion that the appearance of albumen in the diffusate was due to its physical distribution, and was not a true case of diffusion.

The PRESIDENT, in proposing a vote of thanks to Dr. Marcet, took occasion to point out the advantages which often arise out of discussion. If the suggestions offered during the discussion could be put to the test of experiment and the results reported at a subsequent meeting, as in the present case, the data would be the more valuable and reliable.

Professor WANKLYN then read a "*Note on the Action of Sulph-hydrate of Potassium upon Acetic Ether.*" The author had made experiments with the view of determining the constitution of acetic ether by ascertaining the nature of the action exerted by sulphur compounds. Two reactions were possible :—

$$\text{I.}\quad \left.\begin{matrix}C_2H_3O\\C_2H_5\end{matrix}\right\}O+\left.\begin{matrix}H\\K\end{matrix}\right\}S=\left.\begin{matrix}C_2H_3O\\K\end{matrix}\right\}O+\left.\begin{matrix}H\\C_2H_5\end{matrix}\right\}S.$$

$$\text{II.}\quad \left.\begin{matrix}C_2H_5\\C_2H_3O\end{matrix}\right\}O+\left.\begin{matrix}H\\K\end{matrix}\right\}S=\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O+\left.\begin{matrix}K\\C_2H_3O\end{matrix}\right\}S.$$

And the question at issue would be answered by the nature of the sulphuretted product, either mercaptan or thiacetate of potash would be formed. The older view, according to which acetic ether is regarded as the acetate of ethyl, was said to require the production of mercaptan, whilst the new theory lately advocated by Professor Wanklyn would receive support by the formation of the thiacetate of potash, and in this case acetic ether must be considered as the ethylate of acetyl. The two ingredients were heated together in sealed tubes, alcohol being employed as the solvent for the sulph-hydrate of potassium, and upon breaking open the tubes there was evidence of much sulphuretted hydrogen having been liberated, but no mercaptan had been formed. The liquid required a considerable quantity of sulphuric acid to neutralise it, and was tested for the purpose of identifying the thiacetate, but the author appeared to entertain a doubt whether the last-named substance had actually been formed, and preferred to rely upon the non-formation of mercaptan as his strong argument.

The PRESIDENT understood the author to rely upon this reaction as proving that acetic ether had the constitution indicated by the name of "ethylate of acetyl;" but for his own part he could not see that the non-formation of mercaptan was unfavourable to the old view, or that according to which it was called the acetate of ethyl.

Dr. A. W. HOFMANN assumed (correctly) that the alcohol employed by Professor Wanklyn in his experiment was not absolute, but that it contained about ten per cent. of water. Under these circumstances it was necessary to know whether mercaptan could exert any action upon aqueous acetate of potassium.

Professor WANKLYN had tried the hexylic mercaptan, but not the ordinary ethyl-mercaptan. In the first case there was no reaction exerted between it and the alkaline acetate.

Dr. FRANKLAND considered the author's experiments inconclusive; it was not definitely asserted whether thiacetate of potash had been formed.

Professor WANKLYN explained that caustic potash saponified acetic ether with great facility, but the sulphhydrate of potassium did not act at all, or only slowly at a high temperature. According to the old view regarding the constitution of acetic ether the formation of mercaptan was imperatively required.

Dr. ODLING pushed the argument further until it broke down under a want of unanimity on some radical points in the atomic theory and the *modus operandi* of double decomposition.

Professor A. H. CHURCH made some additions to his former communication "*On the Density of Certain Minerals.*" With respect to the increase of density in zircons after ignition, it does not invariably take place, and is often quite inconsiderable. The following list gives the density of several zircons before and after ignition: the specimens were from four localities:—

	Density before ignition.	Density after ignition.
Green River, Henderson Co., North Carolina	4·515	4·540
Ditto ditto	4·667	4·667
Espailly, France	4·863	4·863
Laurvig, Norway	4·658	4·707
Fredericksvärn, Norway	4·489	4·633
" "	4·395	4·438

Mr. Church found that there are two stages in the heating of gadolinite, another mineral the density of which augments upon ignition. In the first stage, the mineral at a low red heat parts with some water; but its density is but slightly increased, and its chemical and physical characters are scarcely affected: in the second stage, at an increased temperature, the mineral becomes phosphorescent, loses its colour, acquires a splintery instead of a conchoidal fracture, and also becomes insoluble in acids.

Density before ignition	4·223
Density after gentle ignition and before phosphorescence	4·275
Density after intense ignition and phosphorescence	4·356

With reference to the garnet beads obtained by fusing Arendal iron-garnet, and referred to in his former paper, Mr. Church finds that they showed, after the lapse of six weeks, no sign of return to the higher density of native garnet—

Density one hour after fusion	3·401
Density six weeks after fusion	3·399

These numbers are practically identical. If a mass of garnet be fused in a platinum cage, it will be observed to bulge out at the moment of fusion between the bars of the cage. Mr. Church concludes from this experiment that the density of garnet is lowered at the moment of fusion. All the density determinations recorded in Mr. Church's two papers were made at the temperature of 15°·5 C., and by the old method of weighing the mineral first of all in air, and then in water free from air. Each determination was repeated twice or thrice. In no case was recourse had to the untrustworthy displacement methods of ascertaining the density of a solid.

Upon the invitation of the President, Dr. A. W. HOFMANN rose to explain that he was partially bound by a promise made to his colleagues in the Council, that in the event of matter failing them at the present meeting, he would hold himself in readiness to offer a few remarks upon some of his recent researches. Some of his friends had likewise exhibited the same accommodating spirit, and as he felt sure the meeting was not now dependent upon his personal exertions, he would much prefer postponing the few remarks he had intended to offer until the next meeting, by which time he should be able to illustrate his subject by experiments.

The PRESIDENT then called upon Dr. G. W. Septimus Piesse to give an account of a little mechanical invention which he believed would have an interest for chemists.

Dr. PIESSE thereupon exhibited a small instrument of foreign manufacture, called "*La Bouffee.*" This was made usually of ivory or glass and ormolu, and was intended to produce cold by the rapid evaporation of a volatile liquid. Its construction was explained by a sketch, which showed it to be made of a short length of glass tubing held vertically in water or other liquid, and with the top orifice contracted to a narrow jet; then at right angles to this was fitted a similar, but shorter, length of tubing, so directed as to be nearly touching the vertical jet. If, then, a blast of air be blown through the horizontal tube, it would create a partial vacuum, according to a well-known principle, in the upright tube, causing the liquid to rise therein and produce a little fountain; but by the further action of the air-blast, this stream of liquid became diffused ("or puffed") into a cloud of spray, which could be made available either for producing cold or for diffusing perfumed vapours in the atmosphere of an apartment. The action of these instruments was practically exhibited, and appeared to excite much interest. Dr. Piesse considered that the principle would serve, with a more powerful blast, many useful purposes in the laboratory; he found no difficulty in lifting water to the height of a two-feet column by the aid of a bellows blow-pipe, and it had been proposed to use the instrument as a kind of spirometer.

At the next meeting of the Society, on December 15, a paper by Dr. Gladstone and Mr. Holmes will be read, besides that of Dr. Hofmann, and the President promised to give a short discourse "*On Chemical Nomenclature and Notation.*" The meeting was then adjourned.

ACADEMY OF SCIENCES.

November 21.

The first memoir read was by M. St. Claire Deville "*On the Dissociation of Carbonic Oxide.*" The author's researches merit the fullest attention, and this paper deserves a complete translation, but we give at once an outline of the experiment detailed in this paper. The author observes that when certain bodies are decomposed at a high temperature their elements are disposed to unite again, and consequently peculiar arrangements are necessary to demonstrate the decomposition. The electric spark decomposes a number of bodies, most probably by the great heat developed, and the reason that this decomposition is not followed by a recombination of the separated elements, the author supposes, is that the small amount of gas traversed by the spark is surrounded by a large atmosphere relatively very cold. He endeavoured to procure similar conditions in the following way. He took a porcelain tube and passed it through a furnace which could be raised to a high temperature. The ends of this tube he closed with corks perforated with two holes. Into one of these he fixed glass tubes to convey the carbonic oxide, and carry off the resulting gas, and by the other holes he carried a brass tube through the entire length of the porcelain tube. This brass tube is to convey a continued stream of cold water. A current of dry carbonic oxide is now passed into the porcelain tube, and the gas from the opposite extremity is carried either into baryta water or through potash bulbs. The presence of carbonic acid is detected as soon as the porcelain tube reaches a bright red heat, and a corresponding amount of carbon is deposited on the cold brass tube. M. Deville points out that the mode of experimenting may be adapted for a variety of examinations.

M. Berthelot, in continuation of his last paper, describes *the calorific effects of the decomposition of formic acid.* He first gives a description of the apparatus employed in his experiments, for which we have no space to-day. The results of the experiment our readers know already. M. Berthelot's deductions are important. His experiments show to him that in some decompositions what we may call an excess of heat is disengaged. Whence comes this excess? Two hypotheses, the author says, present themselves. Either (1) there must exist an external source of active force, which is able to determine a combination and furnish the work expended in its production (this action is analogous to that of light in the formation of vegetable substances); or (2) the effects may only result from changes effected in the internal distribution of the systems—that is to say, two systems of molecules endowed with a certain amount of active force may unite and produce, without foreign action, a new arrangement in which the sum of the work shall be negative. The author's theoretical remarks in general defy condensation, and we proceed to some practical illustrations. The calorific properties of formic acid, he says, may throw some light on the production of animal heat. They show, in fact, that without any combustion heat may be produced in living beings. They prove, further, that the amount of heat developed in the decompositions of the principles which living bodies contain, cannot be estimated by the carbonic acid and water formed, although these may give an approximate idea of the amount. There are bodies, like marsh-gas, which in burning produced less heat than their combustible elements; and there are others, like formic acid, which produce considerably more.

M. Pisani continued his papers on Cornish minerals. He now describes *Brochantite*, *Polianite*, and *Luxuliane*, the last-named from the parish in which it was found, Luxulion, near Lostwithiel. The author mentions that the discovery of these and the Cornish minerals he has previously described was made by Mr. Richard Talling. Brochantite, we should have said, is $\dot{\mathrm{Cu}}_4\dddot{\mathrm{S}}_3 + \mathrm{Aq}$. Polianite is nearly pure protoxide of manganese, and Luxulianite is a porphyroid granite in which mica is replaced by tourmaline.

M. Berthe presented a note confirming the results obtained by M. Claude Bernard in his experiments with *morphia and codeia.*

M. Jullien, manager of the steel manufactory at Lorette, wrote to say that he had completely converted iron into steel by means of graphite. Krupp, he adds, is understood to use nothing else in his factories. Thus, he adds, carbon alone cements iron. Carbonic oxide, he says, will not cement iron. If M. Margueritte obtained anything more in his experiments than blistered iron, it was because his carbonic oxide held carbon in solution; and he adds that if M. Margueritte will analyse the carbonic oxide made in the way he indicates, he will find that it contains more carbon than belongs to the composition of that gas.

NOTICES OF BOOKS.

A Dictionary of Chemistry and the Allied Branches of other Sciences. By Henry Watts, B.A., F.C.S. London: Longman and Co. Part xxii.

In our notice of the last part of this work (p. 238, C. N.) we inadvertently did some injustice to the able editor and principal writer, Mr. Watts, which we are anxious to repair. The entire article on Light was attributed to Dr. Roscoe, which was an error. We were led into this mistake by seeing Dr. Roscoe's initials at the end of the article, but an esteemed correspondent informs us that only the section at the end on the chemical action of light was contributed by Dr. Roscoe. The rest of this excellent article was written by Mr. Watts.

The present part carries the work on from lipyl to magnesium.

A Treatise on Smoky Chimneys; their Cure and Prevention. By F. Edwards, jun. London: Hardwicke. 1864.

One of the two worst domestic discomforts is said to be a smoky chimney; and it is pleasant to learn that this one, at all events, may be cured or prevented. "The following little treatise," says Mr. Edwards in his preface, "has been prepared with the hope that by its aid any man of education may be able to become fully acquainted with the subject of smoky chimneys, to trace out the cause of any such nuisance with which he may be inconvenienced, and apply to it its most appropriate remedy." The author finds that there may be thirteen causes for a smoky chimney, for each of which he points out the appropriate treatment. For example:—"Cause 1. From a fire-place being too open. Remedy. To contract the size of the fire-place or use a contracted grate."

The cause is not always so simple as in the above case, and the treatment requires to be more scientific, but it will all be found in this book, which we may recommend to the notice of men of education who wish to get up the subject of smoky chimneys and learn how to prevent them.

Bulletin de la Société Chimique de Paris, &c. November, 1864.

The present number of the *Bulletin* contains no proceedings of the Paris Chemical Society, but is entirely occupied with the usual abstracts from foreign periodicals. With most of these we have been months in advance of our Parisian contemporary.

Journal für Praktische Chemie. November, 1864.

The greater part of this number is made up of abstracts mainly from the *Comptes Rendus*; but besides these there is a series of papers by Schönbein on the action of oxygen on various metals, thallium, lead, nickel, cobalt, and bismuth, and another on the circumstances under which oxygen unites with oxidisable materials when water intervenes in the reaction. We shall give abstracts of most of these papers.

The American Journal of Science and Arts. Conducted by Professors SILLIMAN and DANA. November, 1864.

AN announcement on the cover of this journal causes us unfeigned regret, and almost tempts us to break the rule naturally imposed upon us, never in these pages to refer to political matters. The announcement is as follows:—

"To Subscribers,—The *Journal of Science* is finally compelled ,to yield to the pressure of high prices like other American periodicals. Instead, however, of increasing the subscription-price, the numbers for the coming year will be reduced in size, yet not so as to make them smaller for the money than the best English scientific journals. . . . We ask for the *Journal* the indulgence and continued support of its subscribers, and promise them that the numbers will again be enlarged when the condition of the country permits of it—which time, we believe, is near at hand.

"SILLIMAN AND DANA."

Every scientific man, whatever his opinions may be, will sympathise with the editors of this valuable journal, and hope that events will justify their belief.

The present number contains an interesting sketch of the life of Heinrich Rosa by his pupil, Professor Dana. From this article we are tempted to make some extracts; for the life of such a man as Rose must naturally have an interest to all chemists. Rose was born on August 6, 1795, at Berlin, where his father and grandfather were chemists and pharmaceutists. His father died in 1807, leaving a widow and four young sons. Heinrich was intended for a pharmaceutist, and was studying pharmacy in Dantzig when that city was besieged by the French, and nearly died of typhus, which prevailed in the town. He and his three brothers afterwards served in the campaign of 1815, and Henrich returned to Berlin in the same year to enter the laboratory of Klaproth. The following year he was engaged in a pharmacy at Mietau, in which town he had the good fortune to make the acquaintance of Grotthus. From Mietau he travelled in 1819 to Stockholm, and gladly accepted the invitation of Berzelius to finish some investigations which he had begun upon the varieties of mica. In Stockholm Rose was joined by Mitscherlich and by his brother Gustav Rose. Rose and Mitscherlich left Stockholm in 1821, and the former proceeded to Kiel, where he took his degree of Ph.D. Here he published his first work. It was in Latin, and on titanium and its compounds with sulphur and oxygen. In 1822 he established himself in Berlin, and in the following year was appointed to the professorship which he held until his death on January 29 of this year.

It is impossible to do more than refer very briefly to the writings of Rose, respecting which the author of the sketch we quote from remarks as follows:—"The writings of Rose consist of his treatise on 'Analytical Chemistry,' and of a great number of articles published in the latter volumes of Gilbert's, and then of Poggendorff's Annals. In considering these writings, it must be remembered that they extend over a period of nearly fifty years. It is difficult to comprehend the circumstances under which works at such a distance of time were composed, to represent to ourselves the state of science previous to their completion. Each of them must be looked at from a different point of view, which is ever changing with the continued advance of science. To judge of them correctly, we must bear in mind what was known at the time when they were written, as well as that which has since been discovered; we must see them neither as they were seen by the contemporaries, nor as they are seen by those of our own times, but rather as they would be regarded by a contemporary who kept up with the knowledge of the present day."

The writer then proceeds to notice in their order some of the most important of Rose's labours, sketching at the same time the previous state of knowledge respecting the various subjects. We cannot follow the writer far in this part, but we give a list of the principal to which Rose devoted himself. His first important work was his investigation of the minerals having the crystalline form of augite, made in the laboratory of Berzalius, in 1820. To this succeeded the researches on titanium, in the progress of which he discovered that rutile, brookite, and anatase, though belonging to different systems of crystallisation, consist essentially of titanic acid, and thus established the first instance of trimorphism in bodies having the same chemical constitution. Several other discoveries of isomeric states of bodies were made in the same course of investigations. A series of papers on the compounds of phosphorus with hydrogen and oxygen form another of Rose's most important contributions to chemical knowledge. The publication of these extended over twenty years, for it was Rose's habit to retain a subject in his thoughts for many years, and publish his investigations from time to time, while in the intervals he was occupied with other works. Another subject which long occupied his thoughts was the chemical decompositions produced by water, which he made a study of a most extended character. Next may be mentioned his researches on the Tantalites, which resulted in the discovery of Niobium and Pelopium, the latter of which he subsequently discarded as a separate element.

Throughout his life, Rose was a firm supporter of the atomic system introduced by Berzelius, and his last paper, "*On a New Series of Metallic Oxides*," published last year, came of some investigations undertaken to confirm the views of Berzelius.

The reputation of Rose will naturally rest upon his great work on analytical chemistry. The first edition (1829) of this work exhibited the earliest attempt at a systematic plan of qualitative analysis. From its first appearance the work was eminently successful, and it has been extended in subsequent editions, until it now forms the most complete treatise on analysis in existence. The last work Rose was engaged upon was an abridgment, for which a number of new experiments were being made. This work is partly printed, and some of the proof-sheets were examined by the author on his death-bed.

Personally, Rose was a most amiable and liberal man. His students and assistants were his friends, and were constantly invited to his house. He never made use of his students to perform the drudgery and routine of his private researches. He seems even to have disliked receiving fees for his instruction. His lectures were illustrated in the simplest manner, and for most of his experiments he required only an ordinary test-tube. His dislike to display gave rise to the story that after his assistant had caused the tarnished spirit-lamps to be brightened, the Professor was found busily employed in restoring them to their former dingy hue. "He could not talk," he said, "amid so much glitter." And with this story we must conclude a very bald abstract of Professor Dana's interesting sketch.

NOTICES OF PATENTS.

Communicated by MR. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2801. William Lingham Lees, Aston, near Birmingham, Warwickshire, "A new or improved composition or cement for uniting or joining substances together, and for other purposes."—Petition recorded November 11, 1864.

2827. Charles Esplin, Tyer Street, Lambeth, Surrey, "Improvements in apparatus for regulating the supply of gas."—Petition recorded November 12, 1864.

2839. John Firth, Sheffield, Yorkshire, "Improvements in the manufacture of steel and iron."—Petition recorded Noveuber 14, 1894.

2762. Arthur Field, Lambeth Marsh, Surrey, "Improvements in the manufacture of nightlights."—Petition recorded November 7, 1864.

2786. William Edward Newton, Chancery Lane, Middlesex, "An improved filter or press."—A communication from Louis Pierre, Robert de Massay, and Louis Robert de Massay, Rue St. Sebastien, Paris, France.—Petition recorded November 9, 1864.

2794. John McCall, Houndsditch, London, and Bevan George Sloper, Walthamstow, Essex, "Improvements in preserving fresh meat, poultry, geme, or fish, and in vessels employed therein."—Petition recorded November 10, 1864.

2800. William Willis, Birmingham, Warwickshire, "Improvements in processes for copying or reproducing by the agency of light drawings, engravings, lithographs, photographs, and written and printed documents."

2806. George Smith, Bradford, Lancashire, "Certain improvements in machinery or apparatus for drying or desiccating materials or substances containing moisture."

2816. Douglas Symonds Sutherland, Great George Street, Westminster, "Improvements in machinery for compressing gunpowder for blasting or other purposes, and in cartridges for blasting."—Petitions recorded November 11, 1864.

2821. Francis Adams Pappe, Bow, Middlesex, "Improvements in malt liquors as tonics."—Petition recorded November 12, 1864.

2840. Jecqnes Jules Renous-Céré, Golden Sqnare, Middlesex, "Improvements in the manufacture of manure."

2842. Michael Henry, Fleet Street, London, "Improvements in the means of, or appliances for treating bodily injuries, affections, and disorders, when atmospheric air is to be excluded from the part affected."—A communication from Jules Guérin, Boulevart St. Martin, Paris, France.—Petition recorded November 14, 1864.

2846. Jean Joseph Montié, Paris, France, "Improvements in treating benzole or its principal composing hydrocarboos, snch as benzine, toluene, or xylene, epplicable also to the treatment of other hydrocarbons."

2854. John Rowley, Grosvenor Terrace, Wells Street, Camberwell, Surrey, "Improvements in the manufacture of printer's ink."

2856. Siegerich Christopher Kreeft, Fenchnrch Street, London, "Improvements in the manufacture of iron and steel."—A communication from Jacnpo Bozza, Naples, Italy.—Petitions recorded November 15, 1864.

2858. Marie Destren, Rue Lamartine, Paris, France, "An improved composition for painting."

2864. William Edward Newton, Chancery Lane, Middlesex, "Improvsments in the manufactnre of soda."—A communication from Auel Baug, Paris, France— Petition recorded November 16, 1864.

Invention Protected by the Deposit of Complete Specification.

2927. Francois Pfanhauser, Winsley Street, Middlesex, "An improved process of tanning."

Notices to Proceed.

1815. Edward Young, Oughtibridge, near Sheffield, Yorkshire, "Improvements in drying and calcining iron and other ores."—Petition recorded Joly 21, 1864.

1827. William Edward Gedge, Wellington Street, Strand, Middlesex, "An improved process or means of decongelating oils." A communication from Eugène Bernard and Eugène Perrin, Faubourg St. Martin, Paris, France.—Petition recorded July 22, 1864.

1833. Dennis Hall, Winsford, Cheshire, and August Ludwig, Roosen, Manchester, Lancashire, "Improvements in the manufacture of salt."—Petition recorded July 23, 1864.

1920. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufecture of glazes or enamels for pottery ware." A communication from Dominique Grosjean, Cossenen, near La Motte, Benoron, France.—Petition recorded August 2, 1864.

1037. Bernard O'Connor, Manchester, Lancashire, "An improved method of making non-inflammable plain and twilled dyed cotton fabrics, called Jeannett's Beetle-twills, rolled shirtings, fancy and striped, and spotted sbirtings, and other cotton goods, printed or otherwise, used for lining dresses and making crinolines."—Petition recorded August 4, 1864.

2486. Cherles Hastings Collette, Lincoln's Inn Fields, Middlesex, "Improvements in magneto-electric machine." A communication from Theodore Faucheux, Avenue Trudaine, Paris, France.—Petition recorded October 10, 1864.

2479. John Ives Vaughan, Appleton-in-Widnes, Lancashire, "Improvements in the manufactnre of resins and resinous substances, and in the apparatus employed therein, parts of such improvements being also applicable to the refining of coal, petroleum, and bone oils, and also paraffine, and analogous acids and hydrocarbons."

2510. Frederick Wilkins, Oxford Street, and Regent Street, both in Middlesex, "Improvements in apparatus for the prodnction of hydrocarbon vapour, and for the applicetion of the same to illuminating or heating purposes."—Petitions recorded October 11, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, December 5.

THE programme of the evening lectures to be delivered at the Sorbonne has just been issued. The literary series commences this evening; the scientifie lectures are delivered on Friday evenings. Both courses ere open to any ons applying for a ticket, which is furnished gratuitously. Among the scientific lectures will be ooe by M. Payen, on Ges-lighting; one by M. Fernet, on Photography; one by M. Wurtz, on Weter; and the last by M. Jamin, on the Magnet.

The Jardin des Plantes has lately received a valuable collection of living animals from South America, including a large Antceter, two species of Rodents new in this country, and a lerge Puma. Altogether forty-two animals heve been presented by MM. Buschental and Lasseau, two French gentlemen settled in Monte Video, but most of them are well known. One of the Rodents, here called *Viscache*, deserves particular mention. It is about the size of a rabbit, and is something like a chinchilla, but has not such beautiful fur. It seems to be a terribly destructive animal, but nature compensates for this by allowing it only to increase very slowly. The mother suckles her offspring for eighteen months, and they do not arrive at maturity before they are four years old. In an agricultural point of view, says M. Milne-Edwards, nothing can be less desirable than tho presence of the viscache in France; but in a zoological point of view they are not without interest, since they belong to a transition type still but imperfectly known.

Another Universal Exhibition will open here on the 1st of March, 1867, and remain open until the 20th of June. This announcement concerns artists more than scientific men, but may perhaps interest some of your readers.

Here is something new from St. Petersburg. On the 1st of last month some experiments were made there with a new method of extinguishing conflagrations. I might have said putting out fires, but that is a phraseology utterly unworthy of a penny-a-liner. The inventor of this method dissolves something in the water which is pumped on the fire, and the solution instantaneously extinguishes the fire. What the substance is is kept secret at present, and all we are told is that it is a white powder having a strong smell. After the fire was put out, the partially-burned wood, it is said, seemed to be covered with a sort of varnish. Is the "white powder" silicate of soda, do you think? Having in view the difficulty in the way of supplying the solution, the journals here suggest that some should always be kept ready in factories and such places to quench the first violence of the fire, which is afterwards to be completely extinguished by common water.

Among recent inventions of some interest I may mention a lamp for burning petroleum oils which does not require a chimney. The inventor blows currents of air upon the wick by means of an apparatus driven by clockwork, and thus obtains a smokeless flame. The additional cost of this apparatus is soon saved by not breaking any glass chimneys.

At a sitting of the Academy of Sciences at Vienna, on October 20, M. Boué presented a list of all the papers written on the artificial production of minerals. They are for the most part of recent date. From 1721 to 1799 only fifty-five memoirs on this subject were published, while from 1815 to the present year 734 have been published. Most of these are by Frenchmen, among whom Ebelmen and Gaudin are the best known.

You will see by the *Comptes Rendus* that M. Pisani is continuing his account of new Cornish minerals. I am not well acquainted with Cornwall, and I am specially ignorant of the whereabouts of Sostevithiel, which I read here is a parish in Cornouailles, where one of these minerals was found.

All good and intelligent Mussulmen, we suppose, believe that the coffin of Mahomet is suspended in mid air by means of powerful magnets—where, a healthy credulity would never ask. These are trying times for faith. M. Plateau, of Ghent, a correspondent of the Academy, has been at the pains of calculating whether it would be possible by any arrangement of magnets to suspend a magnetised needle in the air in a state of stable equilibrium without any point of support; and he announces with regret (for he says *hélas*) that he finds it utterly impossible. And so the legend falls to the ground where the coffin itself (if it remains) has rested for hundreds of years. Some people in England will smile, I dare say, at the reception of such a paper by the Academy; nevertheless, more ridiculous questions were discussed at the Royal Society not many years ago.

Preserving Bodies.

To the Editor of the Chemical News.

Sir,—Although the subject is foreign to those usually discussed in the Chemical News, you will perhaps allow me to mention that your Paris correspondent is in error when he states that it was Dr. Martin Van Butchell who kept his two dead wives in his bedroom; this was Sir John Price who had the two bodies embalmed, and put them up like two statues one on either side of his bed. Dr. Van Butchell's was a more scientific proceeding. He, with the assistance of two Medical friends, injected his wife so that her lips and cheeks kept a healthy natural colour; replaced her eyes with glass substitutes, and then put her into a box filled with plaster of Paris, leaving only the face exposed. A pane of glass let into the box or coffin-lid allowed the face to be seen. A second wife, as your correspondent states, insisted on the burial of the body. Both these stories will be found in Philarete Chasles' "*Dix-Huitiéme Siècle en Angleterre,*" pp. 63-4, from which book, no doubt, your correspondent quoted.

It is almost unnecessary to add that Dr. Van Butchell was a great celebrity in his day. He was a pupil of John Hunter, and used to ride about London to visit his patients on a horse covered over with coloured spots.

December 3. I am, &c. A Reader.

Dr. Morgan's Method of Salting Meat.

To the Editor of the Chemical News.

Sir,—In your report of the proceedings of the Chemical Society meeting on November 17, I find you represent me as stating, in reference to Dr. Morgan's plan of salting meat, "that the quantity of salt might be so much diminished that it became unnecessary to wash the meat preparatory to cooking."

I beg to say that I only expressed my belief that such was the purport of Dr. Morgan's paper on this subject. My impression in this respect agreed with that of other gentlemen present; but I now find, upon inquiry, that there is some doubt whether that impression is consistent with the real facts of the case. I am, &c.

Benj. H. Paul.

8, Gray's Inn Square.

MISCELLANEOUS.

Chemical Society.—The next meeting of this Society will be held on Thursday evening next, when the following papers will be read:—"Action of Ammonia on Sulpho-chloride of Phosphorus," Messrs. Gladstone and Holmes; "Chemical Nomenclature and Notation," Professor Williamson.

New Disinfectant.—Basic nitrate of bismuth, when applied to suppurating wounds, has been found to remove all smell, and hasten the healing up. It has been employed in scrofulous sores with much success.—*Archiv de Med. Milit.*, 1863.

Royal Institution of Great Britain.—The following is the syllabus of a course of six lectures (adapted to a juvenile auditory) on "The Chemistry of a Coal," by Edward Frankland, F.R.S., to be delivered at Christmas, commencing December 27:—Subjects of the course: How coal is put together by nature. How coal is taken asunder by man. Difference between powerful and powerless matter. Materials from which coal is formed:—Water, carbonic acid. Elementary constituents of coal:—Carbon, oxygen, hydrogen. The heat of coal:—How coal burns, and what it produces when burnt:—the glowing cinders—the flame—the smoke—the ashes. The light of coal:—Coal-gas—coal-oil—paraffine, &c. The colours obtained from coal:—Mauve, Magenta, &c. Conclusion.

Cooking without Fire.—M. Babinet, of the French Institute, has laid before the Academy the result of his experiments in this direction. His recipe is:—Place your food in a black pot, cover it with a pane of glass, and stand it in the sun. The water soon boils, and the food is said to be of better flavour than if cooked in the ordinary way.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E C.

C. M. R. D.—The communication is unsuited, and the enclosure has therefore been returned.

C. Eades.—The *Comptes Rendus* of the date mentioned contain all we know of the subject, but particulars are not given. Perhaps our correspondent can favour us with some hints.

W. J. G.—Sir R. Brodie has shown that the existence of the radicals SO_4, NO_6, &c., is very probable. It is difficult to say in these days what chemists believe respecting the intimate arrangement of the atoms of a compound body. Nearly every one holds a different opinion, and, of course, each believes his own.

LONDON SEWAGE.

The "water carriage" system of disposing of the refuse of dwellings being now almost universal in London, and the getting rid of the sewage almost a *fait accompli*, its application as manure involves the consideration of the following questions:—1. What amount of sewage is to be applied to land? 2. Where can it be used? 3. What will be the cost of applying it to the land? and 4. What will be the effect produced by its use as manure?

In answer to the last question, there is the experience gained during many years at Edinburgh, and within a shorter period at Croydon. There are also the results of elaborate and careful experiments made at Rugby by Messrs. Lawes and Gilbert, under the auspices of the Royal Sewage Commission—a *resumé* of which has been given in the Chemical News of April 18, 1863. These have fully confirmed the results obtained at Edinburgh by showing that sewage not only supplied the place of ordinary manure, but produced an increased amount of crop. A further Report of this Commission is expected to appear shortly, and any further reference to these results may, therefore, be deferred till then.

At Croydon the use of sewage was the result of its compulsory exclusion from the river, and the wisdom of that measure has been sufficiently proved by the fact that the sewage which was formerly wasted, has been the means of fertilising and improving 250 acres of land to such an extent that its rent has been increased one-fourth, yielding an income of 250*l.* a-year to the local Board.

At Carlisle similar results have been obtained, and the land to which sewage is applied, has been sublet at an increased rental of about 400*l.* a-year. At Edinburgh, the land to which the sewage is applied was formerly worth only 5s. per acre, and is now assessed at 22*l.* per acre; and the grass obtained from it is worth from 20*l.* to 40*l.* per acre yearly.

Between these several instances of the use of sewage as manure, there are some great differences as to the quantities applied per acre, the kind of land, &c., which are worthy of notice.

At Edinburgh, the land to which the sewage is applied is for the most part very inferior, much of it having been originally mere sand, and the improvement of this land must be considered in a great degree due to an actual formation of soil by the gradual deposition of humoid substances by the sewage. Some part of the sewage is applied to land of superior quality, which was originally worth 6*l.* 10s. per acre, and now yields 30*l.* per acre. The only crop grown with sewage is Italian rye grass. Only part of Edinburgh being under the "water carriage" system, it is only the refuse from some 80,000 of the population which is disposed of as sewage. This is distributed over rather less than 300 acres of land.

At Carlisle, the land which receives the sewage is sandy and porous, and is altogether meadow land. The sewage from 22,000 of the population is distributed over 70 acres of land.

At Croyden, the sewage from 17000 of the population is distributed over 250 acres of loamy soil, on which Italian rye grass is grown.

At Rugby, the sewage of 8000 of the population was formerly distributed over about 450 acres of loamy soil, generally of a heavy kind; but that practice has been abandoned, and it is now all disposed of on some 12 or 15 acres.

The differences in the character of the land at these places would no doubt have considerable influence in determining the relative degree of deodorisation effected by the filtration of the sewage through the soil, and the extent of the nuisance arising from its use in the immediate neighbourhood. At Edinburgh the smell from the sewaged land is almost always very offensive; but this may be due in part to the crude mode of application, and in part, also, to the slight absorptive power of the sandy soil, and the large amount of sewage used per acre.

At Croydon, on the contrary, where the land is of a more absorptive nature, it is stated that there is no nuisance arising from the use of the sewage, and that the water flowing away from the land is colourless, inodorous, and tasteless.

Adopting the assumption referred to last week, that the ingredients of sewage valuable as manure, are worth 6s. per annum for each individual, the following table will show the proportion between these several instances, as regards the distribution of the sewage:—

	Croydon	Edinburgh	Carlisle.	Rugby.
Total value of manure constituents per acre .	£20	£80	£94	£100
Number of population per acre . . .	68	266	314	333

In all these instances the quantity of manure ingredients supplied per acre is very much greater than would be used if they were in a solid state as in guano, or farmyard manure, &c. And wherever the application of smaller quantities has been attempted, as at Rugby, and by the Earl of Essex, at Watford, that practice has been abandoned, notwithstanding the considerable outlay per acre incurred in laying down pipes for distribution, and the application of sewage has been confined to a very limited area relatively to the quantity of manure constituents. Its use has also been confined to meadow land or Italian rye grass, with merely occasional application, in seasons of drought, to other crops.

These, then, are the indications of experience in the use of sewage. On the other hand, it has been contended that the use of sewage is to be regulated by the amount of manure constituents it contains, quite irrespective of the extreme degree of dilution, and that something like one-thirtieth of the quantity used at Rugby would be sufficient to supply to the land as manure.

It must be remembered that in the several instances of the use of sewage as manure, already referred to, the population of the towns is comparatively small, and that their situation is favourable for disposing of the sewage in that manner; but if the doctrine of applying sewage with the hose and jet, as a mere sprinkling, be correct, or even a remote approximation to the truth, the area of land required would be proportionately increased. At the same time the cost of distribution would be largely increased; and after all, the question would remain, would farmers incur the outlay for this purpose, or would they take sewage at all under the circumstances? The answer to these important questions cannot be derived from the mere opinions of *dilettanti*, enthusiastic on the subject of liquid manure.

But there is a more important consideration to be noticed in connexion with this point, as regards the use of London sewage as manure. The quantity of this material to be dealt with at the places already mentioned is trifling compared with that of the London sewage Taking, for instance, the case of Edinburgh, where the sewage of the largest population (80,000) is disposed of on some 300 acres of land, 9000 acres would be needed according to the above estimate, and taking the prospective population of London at about 3,000,000, something like 400,000 acres would be required, or about one-sixth of the entire quantity of land under culture in the whole British Islands. That this conclusion is not exaggerated it may be mentioned that it was stated by one of the witnesses before Lord Robert Montague's committee, that the sewage of London ought to be sufficient for not less than from 500,000 to 600,000 acres of land; and the Coal, Corn, and Finance Committee, in their report to the Common Council of London, quote that statement as having been made by a "competent witness"!!

From this stage, to the notion of London sewage becoming the source of a revenue of some two or three million sterling a year, the passage is easy. With this notion the aldermanic mind seems to be possessed as by a nightmare, and to have become vigorous in denunciation of all contrary opinion. It is, indeed, probable that the coming session of Parliament will show signs of the disturbance to which many stolid and respectable citizens have been subjected by the contemplation of long rows of ciphers, and the immediate proximity of a live Lord. But amidst all these agitating influences, the practical shrewdness of the business man crops out, and the Corporation of London, while vehemently declaiming upon the great value of sewage, does not offer to take its application in hand, though the privilege could no doubt be obtained a bargain; and they expend their efforts in buffeting the Metropolitan Board of Works, for being too precipitate in parting with this treasure, which they fear to lose, but somehow have not courage enough to seize.

Having thus pointed out briefly the general position of the subject at the present time, as regards London, as well as the nature and tendency of the knowledge which has been acquired as to the use of sewage as manure, we purpose in another number to consider the two modes of disposing of London sewage, which have assumed in any degree a tangible form—viz., that of running it down through a covered culvert to sands near the seashore in Essex, where it would be disposed of much in the same way as at Edinburgh; and that of pumping it to the top of Hampstead-hill, and distributing it through a system of pipes over any extent of land where it would be received.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Revision of the Mineral Phosphates—No. IV., Calaite—

by A. H. Church, *M.A., Professor of Chemistry, R. A. College, Cirencester.*

The formula of calaite (turquoise) is generally considered doubtful; that the blue colour of fine specimens of this mineral is due to the presence of phosphate of copper in considerable proportion, and that compounds of iron and manganese are also present in small quantities, seems to be allowed. The action of boiling water and of alkalies upon calaite and the use of the permanganate test indicate that in blue specimens of this mineral the cupric oxide is in union with phosphoric anhydride, and not as hydrate, and that the iron exists almost wholly as a ferrous compound. Some green and dull coloured specimens contain evident traces of a ferric compound, however; in the deep blue kinds the percentage of copper is considerably increased.

For the purpose of analysis a pure blue specimen from Nichabour, Persia, was employed. Its hardness was 5·5; its density 2·75. It was subtranslucent. The exterior, being of a paler tint and somewhat softer than the mass of the mineral, was carefully removed.

·675 grm. of calaite lost ·0033 grm. H_2O *in vacuo* over sulphuric acid.
·6717 ,, ,, ,, ·1287 grm. H_2O on ignition.
,, ,, ,, gave ·005 grm. SiO_2
,, ,, ,, ,, ·0164 grm. Fe_4O_3
,, ,, ,, ,, ·0026 grm. Mn_3O_4
,, ,, ,, ,, ·044 grm. Cu_2O
,, ,, ,, ,, ·268 grm. Al_4O_3
,, ,, ,, ,, ·3425 grm. $Mg_4P_2O_7$

These results correspond to the following percentage numbers, silica and hygroscopic water having been deducted:—

	Per cent.		Per cent.
Fe_2O	2·21	SiO_2	·74
Mn_2O	·36	Hygroscopic water	·49
Cu_2O	5·27		
Al_4O_3	40·19		
P_2O_5	32·86		
H_2O	19·34		
	100·23		

I have previously shown that there are good reasons for believing the iron, manganese, and copper in calaite to be present as the normal phosphates of the protoxides of those metals. One may, then, regard this mineral as containing several phosphates, or as containing phosphate of aluminium in which a portion of the aluminium has been replaced by the metals just named. In either case it will be a perfectly legitimate process to recalculate the percentages of alumina, phosphoric anhydride, and water, after deduction of the ascertained proportions of the phosphates of iron, copper, &c., present. Assuming $Cu_3PO_4+aq.$ as the formula of the normal cupric phosphate, and $(FeMn)_3PO_4+aq.$ as the formula of the mangano-ferrous phosphate, the amounts of metallic oxides found by analysis give the following percentages of their corresponding phosphates:—

	Per cent.
$(FeMn)_3PO_4+aq.$	4·89
$Cu_3PO_4+aq.$	10·47

The residual water, alumina, and phosphoric anhydride correspond after these deductions have been made to the following percentage proportions:—

	Per cent.
Al_4O_3	32·04
P_2O_5	47·11
H_2O	20·85
	100·00

On comparing these numbers with the percentages demanded by the simplest formula that suggests itself, a very close and satisfactory approximation will be observed:—

	Experiment.	Theory, $Al_2PO_4+aq.$ $+Al_2H_3O_3$.
Al_4O_3	32·04	32·45
P_2O_5	47·11	46·99
H_2O	20·85	20·56
	100·00	100·00

By recalculating, on the same principle, the older analyses of calaite, the conclusion to which my results have led me is further confirmed. The formula,

$$Al_2PO_4,aq.+Al_2H_3O_3,$$

is no new one, but previous analytical results seemed scarcely to warrant its acceptance; the differences between experiment and theory were too great. The proposed formula requires us, however, to regard the phosphates of copper, iron, and manganese as intruding salts, not as essential to the constitution of the mineral itself.

A few words as to the analytical methods adopted may not be out of place. From the hydrochloric solution of the ignited mineral the copper was precipitated by a current of hydrosulphuric acid gas; the cupric sulphide obtained was dissolved in nitric acid and weighed as oxide. The filtrate from the copper solution was boiled and oxidised, and then a boiling solution of pure hydrate of potassium added to it in excess. The oxides of iron and manganese remained undissolved; they were washed, ignited, and weighed, their separation being afterwards effected by the use of carbonate of barium, &c. The alumina and the phosphoric acid were subsequently separated by precipitation of the soda solution with pure baryta water, &c.; the alumina was precipitated by sulphide of ammonium.

December 7.

Preparation of Formamide by means of Formiates and Oxalates, by M. LORIN.

ONE of the most usual methods of preparing an amide consists in making ammonia react on the free or nascent acid corresponding to the amide, and then decomposing, by heat, the ammoniacal salt formed. This general method has been applied in several particular instances to formamide. I propose extending its application, and showing once more that the formation of this body is only apparently exceptional.

Formiates.—M. Petersen obtained acetamide by causing hydrochlorate of ammonia to react on acetate of soda; this process serves equally for the production of formamide. With a mixture of equal equivalents of formiate of soda and hydrochlorate of ammonia, assisted by the action of heat, I obtained formamide. The phenomena accompanying the production of this body are identical with those produced by the distillation of formiate of ammonia. I also ascertained that oxide of carbon is produced at the same time, about 12 litres per 100 grammes of formiate, as a secondary product.

Formamide may also be obtained, but not so advantageously, by replacing formiate of soda by formiate of lime, and it is not unlikely that all salts of soda and lime may serve for the preparation of the corresponding amide. However that may be, the reaction of equal proportions of formiate of lime and hydrochlorate of ammonia give results deviating slightly from the preceding—it is, in fact, necessary to raise the temperature; a smaller quantity of gas is disengaged with greater difficulty; and the proportion of formamide produced is relatively less than that obtained with formiate of soda. The gas evolved was a mixture of carbonic oxide and hydrogen, with traces of carbides. Hydrocyanic acid and carbonate of ammonia are also produced. A mixture of formiate of ammonia and chloride of calcium was also tried. In this case also, hydrocyanic acid and carbonate of ammonia are formed, but only a small amount of pure carbonic oxide is evolved. These circumstances, and the rapidity with which the boiling-point of the small quantity of liquid obtained rises, make it probable that formamide is produced in this reaction, though merely in traces.

Oxalates.—Various facts tend to prove the close relation existing between formic and oxalic acids. Among these I will cite that observed by M. Berthelot—the complete transformation of oxalic acid into formic acid and into carbonic acid, under the influence of glycerine, &c. In confirmation of the proposition, that formamide is generated in the same way as all the other amides, is the existence of this body among the products of the decomposition of oxalates of ammonia, neutral or acid, under the regulated action of heat. Gerhardt, in a research, which was the continuation of a remarkable work by M. Balard on oxamic acid, showed that oxalate of aniline, in decomposing, formed at the same time oxanilide and formanilide.

Following his example, I searched for formamide among the products given by oxalates of ammonia.

I operated on these salts dry and crystallised, neutral or acid. Rejecting the portion of the liquid which was below 130°, in the distillation of each of the liquids obtained, then finishing the distillation under slight pressure, and then drying over sulphuric acid, I at last, after a final distillation in partial vacuum, obtained liquid presenting all the characteristics of formamide. To set aside all doubt as to the existence of this body in these reactions, I purified and treated it as follows:—Shaking it from time to time, I left it for several weeks in contact with pure, dry, powdered carbonate of lead; I filtered it, then decomposed by a current of dry sulphuretted hydrogen; again filtered, and finally distilled in a vacuum, all the previous operations having been made in dry air.

I afterwards estimated the last product obtained by ammonia. I found, moreover, that, under the influence of potash, no oxalic acid was reproduced.

The production of gas and carbonate of ammonia by the regulated distillation of oxalates of ammonia, neutral or acid, accords with the composition of these salts. Though neutral oxalate gives a very considerable quantity of carbonate of ammonia, the acid oxalate gives very little. And, as may be foreseen, the neutral oxalate gives very little gas, and the acid oxalates a considerable quantity.

My results are briefly,—1. Formamide is obtained by distilling a mixture of hydrochlorate of ammonia, and a formiate, especially formiate of soda; 2. To the already numerous bodies produced by the regulated distillation of neutral or acid oxalates of ammonia, formamide must be added.—*Comptes Rendus*, lix., 788. 64.

Researches on Hydrocyanic Acid, by MM. BUSSY *and* BUIGNET.

HYDROCYANIC acid has been so thoroughly studied by Gay-Lussac; has been, since its discovery, the object of so many remarkable works, that any farther researches on this subject may possibly be regarded as superfluous. The subject has been, in a way, forced upon us, having to pass in review, for a new edition of the *Codex*, the various processes for preparing hydrocyanic acid, we were obliged to examine every detail, and especially what concerned the yield. As is frequently the case in researches of this kind, the train of experiments and the necessary explanations have led us to extend our work beyond the limits originally assigned to it.

All chemists know that Gay-Lussac was the first to obtain hydrocyanic acid by a process which is still in use—a sure and easy process, consisting in decomposing cyanide of mercury by hydrochloric acid, passing the product on chloride of calcium and collecting it, thus dried, in a conveniently cool receiver.

But it is not so generally known that the process is by no means satisfactory as to the quantity of the product. If we employ for this preparation 126 grammes of cyanide of mercury, and 109·5 gr., of hydrochloric acid containing

33 per cent. of real acid—quantities which correspond to an equivalent of each of the two substances, and which our experiments have shown to be the most favourable to the yield—we obtain, by following the above process, only about 18 grammes of anhydrous hydrocyanic acid—that is to say, only two-thirds of the theoretical quantity; for, according to the equation—$HgCy + HCl = HgCl + HCy$,—1 equivalent, or 27 grms., of hydrocyanic acid should be the result.

This difference can be explained neither by the loss of a small quantity of acid which would have escaped condensation nor by the production of a trace of formiate of ammonia, according to the well-known equation—$HC_2N + 4HO = NH_3,C_2HO_3.HO$.

The missing acid remains entire in the residue, whence it may be extracted by prolonged distillation. But when, during this distillation, the fire is increased, in order to obtain the last traces of the acid, the temperature of the residue gradually rises, even to above 100°, and gradually reaches 110°. Much water and very little acid is then produced; the chloride of calcium liquifies, and it becomes impossible to adhere to the first conditions of the experiment.[*] It is only by modifying them, as we shall show further on, that the whole of the acid, represented by the cyanide, can be obtained in an anhydrous state.

The obstacle to the disengagement of acid proceeds, in this case, from the affinity of the corrosive sublimate formed—an affinity by reason of which the acid is retained in the solution, from which it can only be separated by a relatively high temperature; hence, consequently, it takes with it a considerable quantity of water. To overcome this difficulty, it occurred to us to add to the other matters an equivalent of hydrochlorate of ammonia, which forms, with the corrosive sublimate, a stable combination, long known as sal alembroth. We supposed that, by this combination, the influence of the corrosive sublimate on the hydrocyanic acid would be destroyed, that the acid would be disengaged at a much lower temperature, taking with it but a very small quantity of water, and that we should thus be enabled to collect the whole of it in an anhydrous state, and without in any way modifying the apparatus. The result has fully confirmed our supposition; and by this means the theoretical quantity of 95 centiemes of anhydrous acid is obtainable. The details of the operations have been given in a previous memoir (*Journal de Pharmacie et de Chemie*, xlv., 292).

These observations having revealed to us a special action of the corrosive sublimate on hydrocyanic acid, we wished to complete this study by more precise experiments, and investigated successively the action exercised on water and a certain number of compounds, by hydrocyanic acid. The results described in the present memoir appeared to us to be of sufficient interest in the history of hydrocyanic acid to merit the attention of chemists.—*Annales de Chemie et de Physique*, iii., 231. 64.

TECHNICAL CHEMISTRY.

Use of Petroleum as Steam Fuel in place of Coal,

by B. H. Paul.

Some months ago considerable interest was excited by the announcement that very remarkable results had been obtained in America by the application of petroleum as fuel for the boilers of steam vessels, and so much importance was attached to the subject, that a Commission was appointed by the Government of the Northern States to inquire into this application of petroleum.

The report published by the Commission, as the result of their labours, was calculated rather to excite curiosity than to afford satisfactory information, and they have not, so far as I am aware, made public any further data which would afford a means of arriving at an opinion on the subject.

The proposal to use petroleum as steam fuel in ships became, almost of course, a subject of consideration in this country, and an idea prevailed that this invention might possibly supersede in importance all the recent improvements connected with the naval or mercantile marine. It was anticipated that not only naval warfare, but even navigation itself, might be completely revolutionised by this invention. It was reasonable enough that a project put forward with such pretension as was the case in respect to the use of petroleum as fuel for steam vessels, should be considered in a country where every improvement relating to steam navigation is of high importance; but it is surprising that no one should have disabused the public mind of the erroneous impressions produced by the statements as to the use of petroleum as fuel; for to any one conversant with the composition and characters of petroleum, as compared with coal, this proposed application of it was obviously absurd.

Lately little has been heard of this project until some days ago a notice appeared in the *Times*, under the head of "Naval and Military Intelligence," that experiments are being conducted at the Woolwich Dockyard, with the view of testing the capability of petroleum to supersede coal and other fuel on ship-board, &c. In this notice it was stated that the oil was so utilised "as to be equal for steam purposes to five tons of coals"! How much of the oil was equal to five tons of coals was not stated, but it may be fairly supposed that any one unacquainted with the subject would infer that one ton of oil was meant.

Now, what are really the facts of the case as to the comparative advantages of petroleum and coal as fuel?

In the first place, one of the chief alleged advantages of petroleum over coal, was that it would lie in a small compass and make less demand upon space and tonnage than coal does. Since with petroleum in the place of coal, two-thirds of the space now required for fuel in a steam vessel would be saved, steam ships might keep at sea three times as long as at present. Then, coal depôts would be unnecessary for steam packets on the longest lines of ocean navigation; and since no stokers would be needed in using petroleum, a whole army of employés might be dispensed with.

Now, the specific gravity of coal is from 1·24 or 1·44 to 1·6, while that of petroleum is from 0·800 to 0·850, consequently the weight of a cubic foot of these materials would be, respectively, about as follows:—

	lbs.	lbs.	lbs.
Coal . .	77·4	90	100
Petroleum .		50	53

But, since petroleum, being liquid, lies in a more compact manner than coal; in estimating the spaces occupied by these materials, allowance should be made for the interstices or empty spaces between the lumps of coal. Taking this as amounting to one-third of the whole bulk of a heap of coals—which is a liberal allowance—the contents of a cubic foot would be as follows:—

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[*] This difficulty seems to have been recognised by Gay Lussac himself, for he recommends that the operation should be stopped directly the water begins to volatilise, and that the residue should be used for preparing an aqueous solution of prussic acid.—*Annales de Chemie et de Physique*, lxxvii. and xcv.

	lbs	lbs.	lbs.
Coal . . .	52	60	70
Petroleum . .	50	53	—

So that the spaces occupied by equal weights of coal and petroleum would be about as 1 is to 1·2 or 1·4.

Then the relative heating power of equal weights of coal and petroleum, would depend upon their respective chemical composition, which may be compared as follows for 100 parts:—

	Coal.	Petroleum.
Carbon	83	85
Hydrogen	5	15
Ash, &c.		
	100	100

Accordingly, the relative heating power of equal weights of coal and of petroleum would be in the following ratio:—

	Coal.	Petroleum.
Calorific power . .	1·02	1·50

And the spaces occupied by quantities of petroleum and of coal, having equal heating power, would be in the ratio of 1 to 1·16.

This difference in favour of petroleum is in itself too small to admit of any advantage being gained in regard to stowage, and it is more than doubtful whether there be any other advantageous difference between petroleum and coal for fuel.

It must also be considered how far the difference between the prices of petroleum and coal would have the effect of neutralising the above, or any other advantage to be gained by the use of petroleum as fuel. The price of petroleum varies from 15*l.* to 20*l.* per ton, while that of coal used for steam vessels is under 1*l.* per ton at any part of the British coast, and even at the coaling stations in the East it does not exceed 2*l.* 10s. to 3*l.* 10s. per ton.

These considerations alone appear to me to decide the question as to the practicability of using petroleum as steam fuel under any possible circumstances, for even in the case most favourable for the comparison of petroleum with coal, the cost of equal quantities of heat produced from these materials, would be in the ratio of 15*l.* to 4*l.*

In addition to this, the highly inflammable nature of petroleum must be considered. Its storage on board a ship would require the use of air-tight vessels, and even then there might be considerable risk of the production of explosive mixtures of the petroleum vapour and air. But what would be the condition of a vessel of war provided with petroleum as fuel, if a shot penetrated the vessel containing the petroleum, and allowed it to escape in proximity to the boiler fires?

Taking all these circumstances into consideration, I think there cannot be any doubt as to the entire fallacy of supposing that petroleum can be substituted for coal as fuel; and though this conclusion is sufficiently evident from the data I have adopted as to price, &c., it must also be remembered that the tendency is rather to a rise in the price of this commodity than otherwise.

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.

November 17 and 24.

Major-General SABINE, *President, in the Chair.*

On the above two evenings a paper, "*On the Constitution of Sea-water at Different Depths and in Different Latitudes*," by Professor Forchhammer, of Copenhagen, was read. The number of elements hitherto found in sea-water the author stated to be thirty-one—viz., oxygen, hydrogen, nitrogen in ammonia, carbon in carbonic acid, chlorine, bromine, iodine in fuci, fluorine in combination with calcium, sulphur as sulphuric acid, phosphorus as phosphoric acid, silicium as silica, boron as boracic acid (discovered by the author both in sea-water and in sea-weeds), silver in the *Pocillopora alcicornis*, copper very frequently both in animals and plants of the sea, lead very frequently in marine organisms, zinc principally in sea-plants, cobalt and nickel in sea-plants, iron, manganese, aluminium, magnesium, calcium, strontium, and barium, the latter two as sulphates in fucoid plants, sodium, potassium. These twenty-seven elements the author himself had ascertained to occur in sea-water. The presence of the next four elements—viz., lithium, cæsium, rubidium, and arsenic—has been shown by other chemists. Of these elements only a few occur in such quantity that their determination has any notable influence on the quantitative analysis of sea-water—viz., chlorine, sulphuric acid, magnesia, lime, potash, and soda. The others, as far as their existence has been determined in the sea-water itself, are found in the residue which remains after evaporation to dryness and re-dissolution of the salts in water. The author next stated that, in the water of the ocean far from the shores, the principal ingredients always occur very nearly in the same proportions. If we assume chlorine = 100, the mean proportion of the other leading constituents is as follows:—

	Mean proportion.	Maximum.	Minimum.
Sulphuric acid .	11·89	12·09	11·65
Lime . . .	2·96	3·16	2·87
Magnesia . .	11·07	11·28	10·95
All salts . .	181·1	181·4	180·6

These proportions apply only to specimens obtained at a long distance from shores or in the open ocean. In the interior of the Baltic, for instance, the proportion of chlorine to sulphuric acid is as 100 to 14·97, to lime as 100 to 7·48; and the proportion of chlorine to all salts as 100 to 223·0. This constant proportion of the different constituents in the ocean depends evidently not upon any chemical combination and affinity between the different substances, but upon the enormous quantity of salts in the whole ocean, which renders imperceptible any difference that might otherwise arise from the different proportion in which salts are carried into the sea by rivers. It depends besides on the uniform action of the numberless organic beings inhabiting the ocean, which abstract sulphuric acid, lime, potash, and magnesia from the water, and render them insoluble. The mean quantity of solid matter in the water of the ocean generally the author found to be 34·304 per 1000.

Relative to this paper the PRESIDENT in his annual address made the following observations:—This communication forms a valuable contribution to a great subject—the history of the sea. It contains a full and compendious inquiry into the constituents of the water of the ocean, divided into seventeen geographical regions, each of which is studied separately from samples taken both at the surface and at various depths. An accurate view is thus gained for the first time of the sea as a whole, and conclusions of great generality are obtained. The minute analytical processes followed in several hundred analyses were so conducted as, in the opinion of competent judges, to inspire entire confidence. They confirm the presence in sea-water of the twenty-five elements already reported by other chemists, and add two others, boron and aluminium, to the number. But it is chiefly by the application of the data thus obtained to the elucidation of various geographical problems of great and general interest that we are led to recognise the full importance of this memoir. I may permit myself to notice one or two of the most remarkable of the conclusions established by it. In the Atlantic the saline ingredients in the sea-water (the samples

Dr. Boswell Reid describes one somewhat resembling this, but instead of having the swivel movement, it was necessary to lift the whole apparatus and to invert it. It was in reality two aspirators; one emptied itself into the other.

Dr. Joule described the process he employed to harden steel wires for magnetic needles. The wire was held stretched between the ends of two iron rods bent into a semicircular shape. The free ends of the iron rods could be placed in connexion with a voltaic battery by means of mercury cups. Underneath the steel wire a trough of mercury was placed. When the ends of the iron rods dip into the cups the current passes through the wire, heating it to any required extent. When these ends are lifted the current is cut off, while at the same instant the heated wire is immersed in the trough of mercury.

ACADEMY OF SCIENCES.

December 5.

M. Damour communicated a memoir "*On Callaïs*," a new hydrated phosphate of alumina, some personal ornaments made of which had been discovered in a Celtic tomb in Morbihan. The stone is a species of turquoise of an apple-green colour, which appears to be given by iron, and not by copper. The mineral is translucid, has a compact fracture like wax, is easily scratched with a file, forms a white powder, and has the density 2·50 or 2·52. It disengages water when heated to dull redness, decrepitates, loses its green colour and becomes brown, and is then very friable. It is infusible with the blow-pipe, but borax and microcosmic salt dissolve it easily without colouration. The author analysed the stone, and found the composition answer to the formula,

$$\overset{\cdot\cdot}{Al}_2\,P + 5\dot{H}.$$

He considers that this stone answers the description given by Pliny of a stone, then called Callais, which modern mineralogists consider the Oriental turquoise, hence named Callaite. No sources of these minerals exist in France, and the author considers them both of Eastern origin.

M. Caron sent another memoir on the "*Cementation of Iron by Carbonic Oxide and by Contact with Carbon*," and this time quotes Dr. Percy's experiments in support of his assertion that carbonic oxide will not cement iron. He still insists that cyanogen is the active agent in the conversion of iron into steel, and quotes experiments to show that carbon destitute of alkalies has no effect on iron in contact with it. But when an alkali is supplied, and atmospheric air admitted, cementation is facilitated. Iron also heated with this inactive carbon in an atmosphere of ammonia is quickly cemented.

M. Blondeau presented a note "*On the Action of Nitric Acid on Cellulose.*" In contact with concentrated nitric acid, cellulose, says the author, becomes more and more charged with that acid, until it arrives at a product having the composition $C_{12}H_{10}O_{10}2(NO_5)$. The product placed in dilute acid undergoes a new modification and becomes soluble in nitric acid, disengaging binoxide of nitrogen. By this decomposition it forms *oxalhydric acid* $C_{12}H_{10}O_{16}$. This acid still left in nitric acid further decomposes. Binoxide of nitrogen is again evolved, and oxalic acid remains. These decompositions, he says, illustrate the tendency of all organic matter to assume a simpler and more stable form.

M. Boutin communicated a note "*On the Industrial Advantages to be Gained by Cultivating the Mahonia Ilicifolia.*" This is the small evergreen shrub known in England as the Barberry. The author suggest that the juice of the berries of this plant may be used to furnish alcohol, of which it will yield 8 per cent., of an agreeable flavour, and suitable for making liqueurs. The wine made from it is acid and disagreeable. Further than this, he adds that the pips when roasted made a drink very like coffee in taste and appearance, and quite as useful.

NOTICES OF BOOKS.

"*Our Inheritance in the Great Pyramid.*" By Professor C. Piazzi Smyth, Astronomer Royal for Scotland. Alexander Strahan and Co., London. 1864. Pp. 400.

This book will be read with interest by the general public, but for the scientific reader it possesses unusual charms, on account of the depth of its information, the mathematical ingenuity displayed in its leading arguments, and the interesting historical references to problems in the way of standard weights and measures, and to the discussion of metrical systems which have lately been puzzling the House of Commons, the British Association, and other learned bodies. The frontispiece is a reduction from the excellent original photograph of Mr. Francis Bedford, representing a good view of the Great Pyramid of Jizeh, and there is a coloured map of the ancient pyramid-field in Egypt, besides several well-executed diagrams illustrating points of construction. The work is dedicated to the late John Taylor, Esq., of London, who appears to have devoted his life to the study of everything relating to the Great Pyramid, and upon whose previous literary inquiries in the form of the book entitled "The Great Pyramid: why was it built?" the argument of Professor Smyth is mainly founded.

The work before us sets out with the discovery of a remarkable geometrical proportion, viz., that the height of the pyramid (486 feet) is to twice the length of the base (1528 feet) as 1 : 3·144, or very nearly in the ratio of the diameter of a circle to its circumference. Professor Smyth has reason to doubt the accuracy of the measurements stated above, and he has corrected them to—

Vertical height of pyramid . 486·2567 feet
Breadth of base . . . . . 763·8100 „

When, by the adoption of these numbers, the ratio comes out exactly

1 : 3·14159,

or precisely the relation of the diameter to the circumference of a circle. Proceeding a step further, the author shows that this curious relation may be stated in simpler numbers, thus—

116·5 : 366·0,

the latter figures suggesting the number of days in a year. If, then, the base, multiplied by two, be divided into 366 equal parts, we arrive at the "*primal metron*," or a length of about fifty inches, which Professor Smyth considers to have been the (larger) unit of measurement employed in the construction of the Great Pyramid, and which is exactly equal to $\frac{1}{10,000,000}$th of the earth's axis of rotation.

There are other wonders wrapped up in the history of the Great Pyramid; for example, its square base is very truly oriented, or placed with its sides facing north, south, east, and west; the entrance is a narrow inclined passage opening from the north side, and above it is an air channel for the sake of ventilating the internal chambers. Both these straight channels have directions which suggest the probability of their having been employed for astronomical observation, since they point respectively to the upper and lower culminations of the Polar star of about 4300 years ago, or B.C. 2500.

The object of construction has been diligently sought for, and whilst evidence proves conclusively that all the other inferior pyramids in the neighbourhood were devoted to interment the corresponding features in this monster edifice are wanting. There is no doubt that this was the first of its kind, and that a variety of extraordinary precautions were taken to ensure the safety of its contents, and the very perfection of every part of the building. The rugged exterior is proved to be the result of the removal of the exquisitely finished marble casing stones, the last two of which have been demolished since their discovery, in 1837, by Colonel Howard Vyse, and the apex of the pyramid has been gradually knocked away until now there is a platform on the top "large enough for eleven camels to lie down." However, regarding the interior, there is no likelihood of its having been a royal mausoleum, as were the other pyramids; the sarcophagus is wanting, but, curious to relate, there appears in its place an elaborately finished porphyry coffer, which has been a puzzle to scientific men before and since the days of Sir Isaac Newton. From the perpendicular sides, exactly regular form, and finished workmanship of this mysterious coffer, and absence likewise of any hieroglyphic inscriptions, it has been argued that it must tell its own tale, and that the determination of its precise dimensions must be a matter of vital importance. At page 103 of Professor Smyth's book the recorded measurements of some twenty-five observers are tabulated, and it is truly lamentable to notice the wide discrepancies between their several results. It will scarcely be credited, for instance, that the French academicians committed an error amounting to nearly three inches in taking the depth both inside and outside! And will it be believed that the great master of calculations, the profound Sir Isaac Newton, met in the porphyry coffer a stumbling-block indeed? for we find him actually "taking two measures of the *interior* and one of the *exterior*," in order to get at its cubical contents! The best measurement was that taken as far back as the year 1638 by John Greaves, Savilian Professor of Astronomy in Oxford, corrected subsequently by M. Jomard, which makes the interior of the coffer to be 77·806 × 26·599 × 34·298 = 70,982·4 English cubic inches. What is this measure? Why, exactly the cubical contents of four British quarters of wheat, or 70,982·144 English cubic inches—a lost measure rediscovered, says Mr. Smyth, for many have asked, "What do four quarters really make?"

The chapter on "British Metrology" is a carefully written account embodying the history of England's standard weights and measures—a narrative full of interest. Many of our readers may remember the pint being increased in value by Act of Parliament under George IV., and the old proverbial rhyme—

A pint's a pound
All the world round,

which was made to give place to the modern version—

A pint of pure water
Is a pound and a-quarter.

And old troy weight, according to which "*thirty-two* grains make one pennyweight," &c. And, many will remember the circumstance of the standard yard and pound being lost in the great fire which consumed the Houses of Parliament in October, 1834. How, that in the year following Francis Baily was entrusted with the reconstruction of the standards, and that he reported of the Exchequer standard yard, "that it was impossible to speak of it too much in derision and contempt; for it had been broken asunder, and the two pieces were dovetailed together; but so badly, that the joint was nearly as loose as a pair of tongs." The present standard yard is considered by Professor Smyth to be short of its true length by about one-thousandth part, and he would prefer to rely upon the Exchequer ell, which, according to Graham in 1743, was "found to be ·0494 inch longer than 45 such inches as were contained in the Exchequer yard of 36 inches, but was in excess by ·0075 inch of the Royal Society's scale." Therefore, ·0494 − ·0075 = ·0419 actual excess; and 45·0419 modern inches are consequently equal to 45 old standard inches, or differ in the ratio of 1·00093 : 1. If, now, the "primal metron" already alluded to as having been deduced from the measurements of the Great Pyramid be divided into fifty equal parts, we obtain the smaller unit, or "pyramid inch," which is equivalent to 1·00069 of our present linear inches, and must be, as already shown, $\frac{1}{500,000,000}$th part of the earth's polar axis. In his table of linear measures, page 218, Professor Smyth retains the inch and foot, and proposes a new one of 25 inches to be called the "arm." This length (a half metron) the author imagines to have been employed by the Egyptian artificers as a common rule of convenient length. And it is one which has lately become a favourite scale with the British Government; thus, the new Ordnance Survey maps are *said to be*, but not truly, 25 inches to the mile, or one square inch to an acre. Professor Smith says:—"It *is* truly of the proportion of $\frac{1}{2500}$th of nature; and that gives, on the British measure, 25·344 inches to one mile, and 1·018 inches to an acre as the scale of the maps."[*]

In reviewing the French metrical system (the introduction of which has of late been strongly advocated), Professor Smyth conceived it to be founded upon a false and uncertain basis. The usual definition of a metre is that it shall be equal in length to $\frac{1}{10,000,000}$th of a quadrant of the earth's *surface*!" Now it has lately been shown by M. de Schubert "that the earth's equator is not a true circle, but a rather irregular curvilinear triangle, so that it has many different equatorial axes, and therefore also *different* lengths of quadrants in different longitudes."

Admitting the advantages of a decimal system, but rejecting the French code for the reason just now assigned, our author insists upon the importance of taking a small measurement as the unit, and quotes the evidence of Sir William Armstrong and Mr. Whitworth as supporting his opinion in favour of a standard inch. Sir William Armstrong said at the Newcastle meeting of the British Association that "in the Elswick works, as well as in some other large establishments of the same description, *the inch is adopted as the unit*, and all fractional parts are expressed in decimals." And Mr. Whitworth in his examination before the Lords' Committee in 1855, exhibited an inch measure, with an apparatus for testing its length to the millionth of an inch; and insisted on "the greater importance to all who are engaged in the mechanical arts to have a standard foot and a standard inch, than to have a standard yard."

After giving a full description, in several chapters, of the points of construction and remarkable coincidences involved in the Great Pyramid, Professor Smyth (at p. 302) commences a most interesting account of the difficulties experienced by Francis Baily, Troughton, Kater, the Rev. R. Sheepshanks, and others, in their attempts to construct the modern standards; these failures have arisen from the alterable nature of the materials employed, and the objection is fairly met by the author in his proposal to select porphyry, or other hard, fused, and durable rock for the manufacture of these scales. The first standard of F. Baily was of drawn brass tube, and was condemned in the short space of fifteen years as having altered its size. From wrought metal, which is always seeking to recover itself from the strains of the hammering or rolling, he went to cast metal; and from a soft, flexible metal like brass, he went to hard gun-metal, with an improved result, but still far from perfection. On his death the subject was taken up by the Rev. R. Sheepshanks, who preferred pure metals rather than alloys, and had a great idea of cast copper, notwithstanding its softness, and the trouble of preparing it in a sound state. The opinion of Professor Faraday was asked, and he reported, in 1847, as follows:—"I do not see any reason why a pure metal should be particularly free from internal change of its particles, and on the whole should rather incline to the hard alloy than to soft copper, and yet I hardly know why. I suppose the labour would be too great to lay down the standard on different metals and substances; and yet the comparison of them might be very important hereafter, for twenty years seem to *do* or *tell* a great deal in relation to standard measures."

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[*] It would appear that Professor Smyth is, like the great Sir Isaac Newton, not infallible. The numbers just given are quoted literally from page 221 of the work before us, but the learned professor has surely magnified the error of the Ordnance Survey maps tenfold! A nought is required to be inserted next after the decimal point in the second instance, and their true scale becomes 1·0018 inches an acre.

And later, in 1857, we find Professor Airy communicating to the Royal Society the particulars of 47 bars of gun-metal, 9 of brass, 2 of copper, 9 of forged iron, 4 of cast iron, and 6 of cast steel, then being converted into standards of British length-measure; and these constitute the sum of what the nation has to trust to through future time, the older reference to natural standards having been officially thrown overboard. *Vide* "Report of Treasury Commission on Standards," March 28, 1854:—"We adhere to the recommendation (offered in 1841) that no reference be made to natural elements for the values represented by the standards."

Professor Smyth tells well the story of how the standard pound weight of platinum, prepared only ten years ago, was recently discovered to have become "coated with an extraneous substance produced by the decomposition of the lining of the case in which it was preserved." But for these and many other interesting particulars we must refer to the original work.

On the subject of heat and its registration, Professor Smyth has some good ideas. He recommends a division of the thermometer scale into 250 degrees, ranging from the freezing to the boiling-point of water, and starting (like the centigrade scale) with its zero at the freezing-point. Such small degrees would surely be very convenient, as avoiding fractions for all practical purposes, and would carry out still further the idea which has no doubt served to confirm the use of the unmeaning Fahrenheit scale in this country. The upper limit of Mr. Smyth's scale would be 1000° (=752° Fahr.), or the point at which "iron becomes bright red in the dark," according to the "Natural Philosophy" of the Society for the Diffusion of Useful Knowledge.

The same Temperature According to Five Different Thermometric Scales.

Fahrenheit.	Modified Fahrenheit.	Centigrade.	Reaumur.	C. P. Smyth.
deg.	deg.	deg.	deg.	deg.
32	0	0	0	0
104	72	40	32	100
122	90	50	40	125
212	180	100	80	250

Space will not permit of a more lengthened examination of the contents of this entertaining book. If the statements contained therein are not actual facts, then, indeed, must they be considered as a most remarkable collection of coincidences. We understand that Professor Smyth is about to proceed to Egypt to test for himself the truth of the conclusions drawn by himself and others, and he will be prepared, through the agency of magnesium and photography, to lay open to public observation the mysterious interior of the Great Pyramid. And we may hope eventually to hear from the hero of Teneriffe the relation of his successful travels, and see for ourselves the hidden recesses of one of the wonders of the world by taking no more trouble than is usually attendant upon a journey to Albemarle-street.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2484. James George Bechton, Whitby, Yorkshire, "Improvements in heating retort and other ovens for the distillation of shale, coal, and other substances."—Petition recorded September 20, 1864.

2884. Michael Henry, Fleet Street, London, "Improvements in the mode of, and apparatus for, carbonising wood and performing other operations in which substances are treated by flame or heat."—A communication from Pierre Hugon, Boulevart Saint Martin, Paris, France.

2889. Septimus Piesse, New Bond Street, Middlesex, "Improvements in apparatus for creating and projecting cold vapours."—Petitions recorded November 18, 1864.

2906. Alfred Vincent Newton, Chancery Lane, Middlesex, "An improvement in the manufacture of sugar, and in the machinery to be used therein."—A communication from Charles Rostaud, Rue St. Sebastien, Paris, France.

Invention Protected by Deposit of Complete Specification.

3042. George Tomlinson Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in the manufacture of illuminating gas." A communication from William Elmer, New York, U.S.A.—Petition recorded December 6, 1864.

Notices to Proceed.

1875. Jean Pièrre Chambeyron, Rue de la Fidélité, Paris, France, "Certain improvements in preventing oxidation of iron or steel."

1876. Jean Pièrre Chambeyron, Rue de la Fidélité, Paris, France, "Certain improvements in the manufacture of steel."—Petitions recorded July 27, 1864.

1880. Elizabeth Brinson, Frome, Somersetshire, "Improvements in envelopes or covers for bottles and jars."—Petition recorded July 28, 1864.

1931. Charles Garton, Bristol, Somersetshire, and Thomas Hill, Southampton, "Improvements in mashing apparatus."—Petition recorded August 3, 1864.

1941. Francis Cruickshank, Edinburgh, N.B., "Improvements in coatings for the prevention of the fouling of the bottoms of iron and other ships."—Petition recorded August 4, 1864.

1963. Neil McHaffie, Broad Street, Mile End, Glasgow. "Improvements in treating iron plates for ship-building, boiler-making, and similar uses, and also wrought iron in other forms to render it capable of resisting oxidation or destruction by sea and other water, and atmospheric and other corroding influences."—Petition recorded August 6, 1864.

2806. George Smith, Bradford, Lancashire, "Certain improvements in machinery or apparatus for drying or dessicating materials or substances containing moisture."—Petition recorded November 11, 1864.

2927. Francois Pfauhauser, Winsley Street, Middlesex, "An improved process of tanning."—Petition recorded November 23, 1864.

CORRESPONDENCE.

Continental Science.

Paris, December 13.

A few weeks ago I mentioned the subject of vaccination, and called attention to the practice followed at Naples of vaccinating directly from the cow. The subject has been seriously taken up here, and it is estimated that a good commercial speculation may be made of it. A cow, it is said, will produce 100 pustules, which, at 5 francs each, will bring 500 francs, the cow suffering no deterioration in value. The practice is greatly recommended by the safety it ensures that no other contagion will be communicated along with the cowpox. Smallpox is rather prevalent in and around Paris, and people are becoming anxious on the subject. It is recommended here that the cow should be vaccinated by twelve or fifteen small punctures around the vulva, a part the animal cannot get at. The pustules ripen about the 8th or 12th day. The lymph is too thick to be got into tubes, but must be taken on glass plates, which can be moistened when the matter is wanted. A good idea has been started by one doctor, namely, that it will do just as well to drink the milk of an infected cow as to get vaccinated. The doctor has made the experiment. He vaccinated a cow on the udder and got two good pustules. He then gave the milk to two infants, and afterwards tried to vaccinate them, *but without success*, while a third infant who had had none of the milk was at once inoculated by the same virus. He recommends that young ladies who are afraid of a prick with a lancet should drink a glass of milk every three or four years to save them from the small-pox!!

M. Schmidt recently communicated to the Belgian Academy some observations he made at Athens on shooting stars. He has established some numerical relations between the number of meteors, the detonations, the falls, the tails, and the colours, which may have some interest for your readers. He says that the detonations and falls are fewest when the meteors are most numerous—*i.e.*, in August and November. The greatest number of stars fall in May. Most tails are observed when the meteors are numerous. Red and green coloured meteors are most often seen in summer. The author has noted the colour of 5671 meteors; 4300 of which were white, 905 yellow, 320 red, and 146 green.

Some more information about the Giessen Congress has now reached me through the pages of the *Moniteur Scientifique*, but still intrinsically very little. Most of the chemical papers read—88 per cent. of the total number, in fact—were on organic chemistry, in which department the reporter is not strong; so he shirks the matter, and, indeed, to some extent, pooh-poohs modern organic chemistry. I feel disposed to quote a portion of his remarks, for I believe that there are many chemists who would agree with the substance of them. At one of the sittings, Dr. Hofmann gave a *resumé* of his investigations on the chemical nature of the aniline dyes, and mentioned the interesting fact that it was five-and-twenty years ago, when a simple student at Giessen, that he began his researches on aniline, with little idea, I dare say, that they would ever receive the extensions he detailed that day.

Some other small matters deserve notice. Boettger described a method of writing on zinc, which may be useful to some of your readers, though I am not certain that the method is new in England. He takes one part of chloride of platinum and one part gum arabic, and dissolves them in ten parts of water. With the solution he writes on the zinc, and so obtains black characters, which are unaffected by dilute acids. When the zinc plate is placed in dilute nitric acid, the parts not written upon are eaten away, and the writing stands out in relief. The author suggested that this was a good way of making garden labels for plants. The same gentleman exhibited some mirrors silvered by Bothe's process. The inventor makes use of a mixed solution of ammoniacal nitrate of silver with oxytartrate of silver—(proportions not given)—and the results are said to be very beautiful. Dr. De Vry exhibited a specimen of what he called "the sugar of the future." This is procured from the juice of certain palms growing in Ceylon and Java, and is, it seems, producible with great ease in large quantities. Dr. Frank described the salt deposits at Stassfurt, where, you will remember, a bed of chloride of potassium, or, rather, a layer containing a large proportion of chloride of potassium, is found to overlie a deposit of chloride of sodium. The potassium salt is separated by successive crystallisations, and is obtained tolerably pure, as the English makers of saltpetre know.

Spontaneous generation was, of course, largely discussed at the Congress, and the antiquity of man and the Neanderthal skull were subjects frequently alluded to. The possessor of that skull when alive could have little idea of the noise he would one day make in the world. Lastly, I may shortly mention the paper by Helmholtz on the sounds of muscles, which will no doubt excite great attention, since it serves to explain the first sound of the heart. The author showed that the contractions of muscles are attended with the production of sound, by which he is enabled to determine the number of vibrations in the muscle. You will, no doubt, have the entire paper in England soon, and will see the importance of the matter to the physiologist and physician.

MISCELLANEOUS.

Renard v. Levinstein.—This important trial commenced on Tuesday last, before Vice-Chancellor Page Wood. The subject in dispute, our readers will remember, is a patent for the production of a blue dye granted to M. C. A. Girard. The specification of this patent will be found below. It will be in the recollection of our readers that an injunction was granted by the Vice-Chancellor to restrain the defendant from making a blue aniline dye, which injunction was dissolved by the Lords' Justices, on the grounds that no infringement of Girard's patent had been proved, and that the validity of the patent was open to dispute. The present is a trial without a jury to establish the validity of the patent, and prove the infringement by the defendants. An unusual amount of interest has been given to this trial by the circumstance that a number of eminent French chemists have been examined for the plaintiff. Besides the patentees, MM. Girard and Delaire, of the French mint, MM. Persoz, Cahours, and E. Kopp, have given evidence, the last in excellent English. Besides these, Drs. Hofmann and Frankland, Mr. Abel, and several other London chemists, were examined for the plaintiff, whose case had not concluded at the early date on which we are compelled to go to press. In our next we shall give a succinct *resumé* of the evidence on both sides. In the meantime we publish the specification of the patent which is the subject of dispute.

"Letters Patent to Charles Adam Girard, of 17, Boulevard du Temple, Paris, in the Empire of France, for the invention of 'Improvements in preparing colouring matters for dyeing and printing.'—Partly a communication from abroad by Mr. Georges de Laire, of the Mint, in Paris.

"Sealed the 9th July, 1861, and dated the 12th January, 1861.

"Provisional specification left by the said Charles Adam Girard at the office of the Commissioners of Patents, with his petition, on the 12th January, 1861.

"I, Charles Adam Girard, of 17, Boulevard du Temple, Paris, in the Empire of France, do hereby declare the nature of the invention for 'Improvements in preparing colouring matters for dyeing and printing' to be as follows:—

"For these purposes red aniline dye is purified and mixed with a quantity of aniline. The proportions which I prefer to employ are about equal quantities of aniline and of red aniline dye. The mixture is maintained for several hours at a temperature between 155° and 180° (Centigrade), and as nearly as possible to 165°. The substance, which is now violet, is boiled with a mixture of water and hydrochloric acid. The excess of aniline and of red dye which has not been transformed is dissolved, and a violet residue remains. This residue is completely soluble in alcohols, acetic acid, wood spirit, and boiling water slightly acidulated with acetic acid. All these solutions may be employed directly for dyeing violet. In order to obtain the blue dye the violet mass is boiled several times with hydrochloric acid diluted with a small quantity of water and then washed with boiling water. The substance thus obtained is a blue having a beautiful coppery lustre. To employ this colour in dyeing it is sufficient to dissolve it in vinegar, or alcohol, or wood spirit, and to dilute these solutions with a convenient quantity of water. I would state that liquids obtained by treating the violet mass with hydrochloric acid and water contain, as I have said, hydrochlorate of aniline and red dye. They are precipitated by an alkali, and aniline, which may be purified by distillation, is thus recovered.

"Specification in pursuance of the conditions of the Letters Patent, filed by the said Charles Adam Girard in the Great Seal Patent Office on the 12th July, 1861.

"This invention has for its object improvements in preparing colouring matters for dyeing and printing. For these purposes I take red aniline dye, a substance now well known, and which is prepared from aniline, or more commonly from a mixture of aniline with its homologues, and which may be prepared from the homologues of aniline, and this dye having been purified in the usual manner, is mixed with a quantity of aniline. The proportions which I prefer to employ are about equal quantities by weight of aniline or its homologue and of red aniline dye. The mixture is maintained for several hours (say about five or six) at a temperature between 155° and 180° (centigrade), and as nearly as possible to 165°. The substance, which is now violet, is boiled with a mixture of water and hydrochloric acid, say ten or twelve parts of acid to one of the substance, the acid being mixed with a large quantity of water, and the boiling is continued until the washing is complete. The excess of aniline and of red dye which has not been transformed is dissolved, and a violet residue remains. This residue is completely soluble in alcohol, acetic acid, wood spirit, and boiling water slightly acidulated with acetic acid. All these solutions may be employed directly for dyeing violet. In order to obtain the blue dye the violet mass is boiled several times with hydrochloric acid diluted with a small quantity of water, say ten parts of hydrochloric acid of commercial strength to one hundred parts of water, and then washed with boiling water, the boilings being continued until the operation is complete, as will be readily ascertained from the appearance of the dye. The substance thus obtained is a blue, having a beautiful coppery lustre. To employ this colour in dyeing it is sufficient to dissolve it in concentrated acetic acid, alcohol, or wood spirit, and to dilute these solutions with a convenient quantity of water. I would state that liquids obtained by treating the violet mass with hydrochloric acid and water contain hydrochlorate of aniline and red dye: they are precipitated by an alkali, and aniline, which may be purified by distillation, is thus recovered. I would also remark that, in place of first preparing a red dye and purifying the same, a similar result may be obtained by treating aniline with reagents, such as are ordinarily employed to convert it into red dye, but using an excess of aniline, so that the first action is to convert a part of the aniline into red dye, and then, the heat being maintained as hereinbefore mentioned, the excess of aniline converts the red dye into the violet substance; I prefer, however, to conduct the process in the manner first described.

"Having thus described the nature of my invention, and the manner of performing the same, I would have it understood that what I claim is the treating red aniline dye with aniline or its homologue so as to transform it into other dyes, as hereinbefore described."

Dublin International Exhibition, 1865.—On Wednesday evening last Sir Robert Kane delivered a lecture at the Society of Arts "*On the Recent Progress and Present State of Industry in Ireland*, and *the Dublin International Exhibition of* 1865." The meeting was exceedingly well attended; and the prospects of the coming Dublin Exhibition look remarkably promising. We may inform our readers that the arrangements of classes will be the same as at the London Exhibition of 1862. Class A, section 2, will comprise chemical and pharmaceutical processes and products generally; and a section of Class B will include philosophical instruments and processes depending on their use, photographic apparatus, surgical instruments, &c. All these manufactures, we should hope, would be well represented from England. One of the Committee, who has visited all the principal seats of industry on the Continent, has returned with flattering promises of support from the manufacturers, and great encouragement from the various governments. The building, we may state, is already approaching completion; and the Exhibition will open on Tuesday, May 9. A London Committee of Advice, of which Mr. P. L. Simmonds is secretary, sits at the house of the Society of Arts, from whom any information that intending exhibitors wish for can be obtained.

Serious Case of Poisoning.—We are happy to be able to state that the case of poisoning at York, related under the above heading in our number for December 3, has been shown to be simply the result of an excessive dose of morphia, and not the consequence of a mistake on the part of Mr. Hardman's porter. Dr. Proctor, who has been kind enough to forward us his evidence at the inquest, made a post-mortem examination of the body and an analysis of the contents of the stomach. In the latter he discovered no other poison besides morphia, which it was known the deceased had long been in the habit of taking. The heart of the deceased showed signs of fatty degeneration, and the verdict was death from that cause, accelerated by an overdose of morphia taken voluntarily.

Actonian Prize Essay of 200 Guineas.—Attention is directed to the following advertisement, which appeared in the *Times* of May 28, 1863. It will be seen that the latest period for the acceptance of the essays is fixed at a fortnight from the present date.

(Copy.)

"Royal Institution of Great Britain, Albemarle Street.—The next Actonian Prize or Prizes will be awarded in the year 1865 to an Essay or Essays illustrative of the Wisdom and Beneficence of the Almighty as manifested in any of the Phenomena of Radiation. The prize fund will be 200 guineas, and may be awarded as a single prize, or in sums not less than 100 guineas each, or withheld altogether, as the Managers in their judgment should think proper.

"Competitors for the prize are requested to send their Essays to the Royal Institution on or before ten o'clock p.m., December 31, 1864, addressed to the Secretary; and the adjudication will be made by the Managers in April, 1865. "H. Bence Jones, Hon. Sec., R I.

"May, 1863."

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E C.

Leather Dresser.—There is no work which we can recommend you.

Dr. Adriani.—It is obviously only an abstract, but it is all that has reached us.

J. Sutcliffe.—It can only be procured in a volume with the rest of the reports.

J. B. Pearse, United States Army Laboratory.—There is great difficulty in procuring the work, but we will do our best for our correspondent.

J. J.—Zinc-ethyl, but it must be sealed in a tube. Lead pyrophorus, a powder, will do as well, and is much more easily procured

Kamptulicon.—The material to which you refer is a combination of cork raspings and india rubber. You are mistaken in supposing the latter to be in the vulcanised condition, for on digesting with coal-naphtha the rubber is easily dissolved, and its proportion may be ascertained by recovering it from the filtered solution on the evaporation of the solvent, or indirectly by weighing the cork.

A Brazier.—Common brass always contains lead, and sometimes a little tin, in addition to copper and zinc. The composition of the best sheet-brass varies from 66 to 70 per cent. of copper, the rest being zinc. There can be no doubt that the addition of iron does confer increased strength, but there is then a liability of the alloy rusting by exposure. For further particulars, see "Percy's Metallurgy," Vol. I.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Notes on the Platinum Metals and their Separation from Each Other, by M. C. LEA, Philadelphia.

PART I.*

(Continued from page 281.)

The reaction of the alkalies on the chlorides of iridium are altogether peculiar. Upon the bichloride they exert a reducing effect, converting it into sesquichloride. An excess of alkali does not precipitate the sesquioxide, but seems to hold it in solution. On the application of heat the sesquioxide gradually oxidises itself at the expense of the atmosphere, and is then precipitated as deutoxide of iridium. If to the cold solution containing excess of alkali an acid be added in small quantity, an impure sesquioxide is precipitated, in consequence of the neutralisation of the alkali which held it in solution. But the sesquioxide thus precipitated always contains a considerable quantity of the alkali used. It is very unstable, and by the action of the air is rapidly converted into blue oxide. This is nearly all that we know of the sesquioxide of iridium.

Under these circumstances it appeared to me desirable to investigate the action of some of the alkaline earths upon iridium solutions, which, it seemed possible, might throw a clearer light upon the relations of the sesquioxide.

When a solution of caustic baryta is poured over iridium sal ammoniac, the iridium salt rapidly dissolves with a slight effervescence; the solution presently becomes comparatively decolorised, and a dark olive-green precipitate falls. This reaction, it will be observed, is completely different from that caused by potash.

The filtrate from this precipitate, which precipitate is but small in quantity, still contains a large quantity of iridium. If it be exposed to heat as soon as it is moderately warm, its dark olive colour changes almost suddenly to an Isabella colour, it becomes cloudy, and an abundant precipitate falls, which, in different experiments, varies from pale grayish-yellow to yellowish brown.

It was intended to submit both of these precipitates to a rigorous analysis; but the first was obtained in too small quantity—a few centigrammes only. The second substance was much more abundant in quantity. A portion of it was prepared with great care, and with thorough exclusion of air, to prevent any admixture of carbonate of baryta. But upon careful examination it was not sufficiently homogeneous in its composition to enable one to draw positive conclusions from an analysis, and the intention was, therefore, abandoned. The following were the properties observed:—

The olive green precipitate seemed to be permanent in the air, and contained no baryta, or at most only traces. It dissolved in acids, leaving, however, a trace of black powder behind, and gave an olive-coloured solution, indicating that the iridium was in the condition of sesquioxide.

The Isabella-coloured precipitate contained a considerable quantity of baryta. It dissolved in acids, and gave, when freshly prepared, also olive-coloured solutions. When dried at 212°, it was completely converted into an indigo-coloured mass, which dissolved in acids to an intense blue solution. When allowed to dry at ordinary temperatures, even by exposure to the air, it was only oxidised in small part.

To observe the action of potash on this compound, a portion of the Isabella-coloured precipitate was placed in a watch-glass, and a little caustic potash solution was poured over it. In a few minutes a blue tint was observable along the borders of the solution, and by exposure for a few hours the whole precipitate became intensely blue. We thus see that while potash is capable of reducing the bi- salts of iridium to sesqui- salts, its presence causes the sesquioxide to take up oxygen from the atmosphere, with production of bioxide; and that, for this action to take place, it is not necessary that the sesquioxide should be in that anomalous state of solution in alkali, in which it seems to exist in solutions of bichloride decolorised with excess of alkali; but that the barytic compound here described, which is comparatively more permanent by itself, commences immediately to oxidise rapidly when placed in contact with potash.

Other reactions of platinum metals with baryta are as follows:—

Sesquichloride of Ruthenium and Ammonium is immediately and completely precipitated by baryta in the cold.

Bichloride of Ruthenium and Ammonium gives no precipitate to the cold. Heated, it turns yellowish-brown, and becomes turbid. This turbidity is completely removed by the addition of a large excess of the precipitant. If the baryta have been added to large excess at first, no turbidity is occasioned by the application of heat.

Protochloride of Palladium is precipitated immediately in the cold by baryta. The brownish yellow precipitate does not re-dissolve in excess of the precipitant. In this the reaction of baryta differs from that of potash.

Bichloride of Platinum is scarcely affected by baryta water in the cold. Heat immediately produces a dirty white precipitate, the supernatant liquid remaining of a yellow colour.

Sesquichloride of Rhodium gives an immediate light coloured precipitate with baryta, which completely redissolves in a very large excess of the precipitant, even in the cold.

It will be seen from the foregoing that the reaction of baryta with the platinum metals differ widely from those produced by potash, and are highly characteristic.

Two of these solutions which much resemble each other, those of bichloride of ruthenium and sesquichloride of rhodium, are very well distinguished from each other by baryta, the former remaining for some time clear, the latter being instantly precipitated. The production of a well-marked precipitate is generally a better test than a mere change of colour, as produced by potash, which has hitherto been considered the best reagent to distinguish between these two substances.

The relations to colour of the double sesquichloride of iridium and ammonium—

$$3NHCl,Ir_2Cl_3+3HO,$$

are curious, and have not been exactly described. It is generally said that its solution is olive green by reflected, and reddish by transmitted light. The following is a more correct description:—

A dilute solution of the salt is always olive green, whether seen by reflected or transmitted light. If it appears red by transmitted, when very dilute, this can only arise from the presence of bichloride of ruthenium, or sesquichloride of rhodium.

As its concentration increases, it gradually acquires a red colour, visible by both reflected and transmitted light, but more conspicuous by the latter. A very strong

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[*] *Am. Journ. Science and Arts*, No. 112, Vol. xxxviii.

solution is almost opaque to transmitted rays; by dilution passes to a deep wine red. This wine red solution is by reflected light olive green, but with a distinct tinge of red. Nor has it before been remarked, I believe, that the crystallised salt exhibits the same dichroism. The crystals are deep green, by reflected light almost black. When placed so that light can strike through a dihedral angle, its colour is ruby red.

Strong and weak solutions of this salt differ so much in colour (in tint, not merely in intensity) that at first one has a difficulty in believing that they contain one and the same substance.

New Ruthenium Reaction.—A series of experiments on the reactions of the platinum metals are as yet unfinished, but I take the present opportunity to mention a new and very beautiful reaction of the sesquichloride of ruthenium.

When a solution of hyposulphite of soda is mixed with ammonia, and a few drops of solution of Ru_2Cl_3 are added, and the whole boiled, a magnificent red purple liquid is produced, which, unless the solutions are very dilute, is black by transmitted light. The colouration is permanent, and the liquid may be exposed to the air without alteration.

This reaction is obtained with great ease and certainty, and will, I believe, be found far superior to any known test for ruthenium.

In order to determine the limits of the sensibility of this reagent, experiments were made with ruthenium solutions of different strengths. A portion of perfectly pure Ru_2Cl_3 was weighed out in a delicate balance, and the following indications were obtained:—

With $\frac{1}{5000}$th Ru_2Cl_3 bright rose purple.

With $\frac{1}{20000}$th and $\frac{1}{30000}$th, fine rose colour.

With $\frac{1}{50000}$th, paler, but still perfectly distinct.

With $\frac{1}{100000}$th, the colour, though very pale; was still unmistakeably present.

Where the solutions are so very dilute as these last, the boiling must be continued for some minutes.†

Although the sulphocyanide test is very delicate, it is not equal to this, as was determined by a comparative trial. It is also liable to the objection that when employed to examine mixtures the presence of iron might be confusing. For although the reaction of ferric salts with sulphocyanide gives a different shade of red, yet it is to be observed that the two colours approach each other considerably when much diluted. Moreover, in using the sulphocyanide test, I find it best to acidulate the liquid strongly with chlorhydric acid, and to obtain a chlorhydric acid absolutely free from iron, so that it does not give the slightest colouration with the sulphocyanide. It is generally necessary (in America, at least) to prepare it for oneself.

The delicacy of this test does not, however, constitute its greatest value and superiority. The reactions of ruthenium are remarkably affected by the presence of iridium; and in proportion as this last-named metal is present in larger quantity, the indications afforded by all the tests hitherto known grow less and less decided, and some lose all efficacy. The test here proposed is the first known reagent that is capable of detecting ruthenium in the presence of any excess of iridium. No precautions are necessary, and the reaction is always obtained with the greatest facility. The iridium solution is to be rendered alkaline with ammonia, a crystal of hyposulphite of soda is dropped into it, and the whole is boiled for two or three minutes. If no indication of a red purple tint appears (or, in case of small quantities of ruthenium, a rose colour), the iridium solution may be pronounced free from ruthenium.‡

It would appear that there must exist very beautiful purple and green compounds of ruthenium, with which we are at present unacquainted. The purple compound appears to be produced in several reactions, and notably in that just described, and in the sulphocyanide. There can be little doubt that sulphur enters into its composition. The green compound is produced when a solution of Ru_2Cl_3 is boiled with ferrocyanide of potassium. Claus remarks in reference to this colouration that he is unable to explain its cause. It is, however, unquestionably due to a compound of ruthenium, and not to the production of any prussian blue or green compound, for I find that the green reaction can be obtained in presence of a large excess of free ammonia, together with which it is hardly necessary to remark, the last-mentioned compounds could not exist. I propose to return to the subject of the ruthenium reactions at a future occasion.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 15.

Professor A. W. Williamson, Ph.D., F.R.S., *President, in the Chair.*

At this meeting there was an unusually large attendance of members, and the Society was favoured by the presence of Professor Emile Kopp and other visitors.

Dr. Hermann Sprengel and Mr. A. P. Turner were formally admitted Fellows of the Society, and Mr. Alexander Stewart, Apothecaries' Hall, London, was duly elected by ballot. The names of Mr. Alfred Noble, Bristol, and Mr. J. Carter Bell, Manchester, were proposed for the second time, and will be balloted for at the next meeting; and the names of the following candidates were read for the first time:—viz., Mr. Charles Eastcourt, Manchester; Mr. Thomas Porter Blunt, B.A., Oxon., Shrewsbury; Mr. Robert M'Donald Bosanquet, Oxford; Mr. Nathaniel Bradley, Prescot, Lancashire; Mr. Richard Percival, University of Glasgow; Mr. Thomas Heathcote Windham; Mr. Arthur Smith, Loughborough Road, Brixton; Mr. Arthur Vacher, 29, Parliament Street, London; and Mr. Francis Walker, Sidney College, Cambridge.

Dr. J. H. Gladstone then read a paper "*On the Action of Ammonia on Sulpho-Chloride of Phosphorus,*" which describes the results of experiments made by himself and Mr. J. D. Holmes in continuation of the research communicated on a former occasion, and printed at page 225 of the second volume of the Society's journal. The authors state the sulpho-chloride of phosphorus is capable of absorbing four equivalents of ammonia gas, with production of a white coherent mass, which consists of chloride of ammonium in admixture with a substance of doubtful composition, probably $P(NH_2)_2ClS$, but which is decomposed by contact with water into hydrochloric acid and a new body, named thiophosphodiamic acid, and having the formula $P(NH_2)_2HS\Theta$. The last-named substance, or rather the aqueous solution of the crude product, after being neutralised, has the property of forming flocculent precipitates with a variety of metallic solutions. The most characteristic of these were the cadmium, zinc, and copper salts, which were submitted to analysis, and found to be true thiophosphodiamates of these metals respectively; and from these numbers the composition of the acid itself was deduced, since it was found impossible to isolate the latter either by digesting the silver precipitate with hydrochloric acid or by decomposing the copper salt with sulphuretted hydrogen. The authors state that Hugo Schiff[*] had previously made experiments upon the action of ammonia on the sulpho-chloride, and had correctly described the physical changes; but, in the absence of analyses, had been led into erroneous speculations regarding the nature of the chief product. He predicted the formation of sulphosphotriamide,

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† When the presence of ruthenium in very small quantity, or in very dilute solution, is suspected, it is often advisable to boil the solution with a little chlorhydric acid, previous to the application of the hyposulphite, sulphocyanide, or other test. The explanation of this will be given in the second part of this paper. With the hyposulphite test, the acidulated solution must be rendered alkaline by addition of ammonia before heating with hyposulphite.

‡ The second part of this paper will contain an examination of the reaction of hyposulphite of soda, and other reagents, upon the various metals of the platinum group.

$$\left.\begin{matrix} PS''' \\ H_2 \\ H_2 \end{matrix}\right\} N_3;$$

but this has not been established by the authors' results. If, instead of submitting the sulphochloride of phosphorus to the action of ammonia gas, it be brought into contact with aqueous ammonia, the water takes part in the reaction, and there is produced, besides chloride of ammonium, the ammonium-salt of another acid called thiophosphamic acid, and having the formula

$$P(NH_2)H_2S\Theta_2,$$

the cadmium and lead salts of which were analysed for the purpose of establishing its composition. The reaction expressing this change was described thus :—

$$PCl_3S + 6NH_3 + 2H_2\Theta = 3NH_4Cl + PNH_2(NH_4)_2S\Theta_2.$$

The President, in proposing a vote of thanks to the authors, remarked upon the complexity of the compounds just described, and stated his conviction that the Society would be glad to hear an account of Dr. Gladstone's further and unpublished researches.

Dr. Hofmann inquired whether the authors had examined the action of sulphochloride of phosphorus upon aniline, the latter substance giving frequently rise to the formation of compounds the investigation of which, owing to their superior crystallising power, presented less difficulty than that of the corresponding ammonia derivatives.

Dr. Onlino considered the authors' views to be quite orthodox; they had a parallel in the formation of chlorocyanuramide.

Dr. J. H. Gladstone said that, although most of his precipitates were flocculent and amorphous, the cadmium salt showed a disposition to crystallise. He had not himself examined the aniline reaction, but all M. Schiff's statements regarding the action of ammonia were correct. His theory alone was bad, for he had never analysed the compounds.

At this stage of the proceedings the President vacated the chair, which was thereupon taken by Professor Graham.

The President then delivered a short discourse "*On Chemical Nomenclature and Notation.*" The lecturer commenced by referring to the unsatisfactory condition of chemical nomenclature at the present time, when each author felt himself at liberty to adopt a system of his own, which became intelligible to his readers only after a careful study of the formulæ and critical examination of the simpler equations. Such was the state of confusion that it was deemed advisable by the Council, during the last session, to appoint a committee to inquire into and report upon the whole subject; and as a member of this committee, he felt somewhat diffident in appearing before the Society in an individual capacity. The committee had held a few meetings and made some progress, but was not likely to bring its labours to a definite point. In the meantime, being a teacher of chemistry, compelled to work, and now engaged in writing an elementary treatise, he could no longer forbear coming before a general meeting of chemists and asking their advice upon this fundamental topic. That which he now proposed to discuss was not a novel system, but an attempt to establish a ground of general agreement upon which afterwards a superstructure might be raised. He considered that the introduction of new words which had not been adopted was productive of much evil, and many old words had been used with an entirely new signification, but if a good system of nomenclature were once devised it would lend powerful aid to thought. There were, perhaps, no words in use among chemists of which the original meaning was so clear as the words acid and base. They were introduced to describe bodies of opposite properties, which were more or less completely lost in the salt, or compound of acid and base. The process of combination was, no doubt, judged from the simple cases of it which had been investigated, and in which, by the juxtaposition of two molecules, one molecule of the compound was produced, thus—

$$SO_3 + BaO = SO_4Ba. \qquad SiO_2 + PbO = SiO_3Pb.$$

Later research showed that two molecules might, by chemical combination, form two molecules of the product. Thus—

$$ClCl + HH = HCl + HCl.$$

In a similar manner we now know that one molecule of alcohol does not contain one molecule of ether united to one of water, but that two molecules of alcohol are formed by such combination. Several reactions originally supposed to be simple combinations have been proved to be cases of double decomposition, and Lanrent and Gerhardt have been among the most active of modern chemists in advancing this method of explanation; but one of them fell into the error of asserting that this was universally the case, and applied the term acid to hydrogen salts, gave the name anhydride to acids, and left bases, however anhydrous they might be, without a name! The author denies the right to use a well-established name in any other than its original signification, unless the most conclusive proof can be advanced as showing that the word will not be again wanted for its original purpose. Gerhardt was no doubt sincere in his belief that compounds of fundamentally opposite properties, usually denoted by the words "acid" and "base," did not unite to form one or more molecules of a comparatively neutral compound; and, thinking the idea obsolete, did not hesitate to adopt the word acid, and use it in a modified sense as part of his own general scheme. In illustration of the fact that two molecules may unite to form one complex molecule, Professor Williamson quoted the following instances of direct combination :—

$CO + Cl_2 = COCl_2.$

$C_2H_4 + Cl_2 = C_2H_4Cl_2.$

$Hg + Cl_2 = HgCl_2.$

$NH_3 + HCl = NH_4Cl.$

$SiO_2 + K_2O = SiO_3K_2.$

$SO_3 + (C_2H_5)_2O = SO_4(C_2H_5)_2.$

The author conceives that the oxide of lead is an active base at high temperatures, because it so readily passes into the fluid condition, which is necessary to promote contact with an insoluble acid body upon which it is made to act. In the same way water is considered a menstruum, and by virtue of its fluidity, and the solvent power which it is able to exert, it brings the particles into absolute contact, so that a union may be effected which is often otherwise impossible, as with the so-called "anhydrides," for instance, from the fact of their being in an unsuitable physical condition. For these among other reasons Professor Williamson believes that the bodies misnamed "anhydrides" are true acids, and asserts that the hydrogen salts cannot with propriety be called "acids." Of the compounds of hydrogen with chlorine and bromine it would not be incorrect to say that they have acid properties without being in themselves acids; in fact, they may be viewed like most of the known compounds of indifferent or neutral metals, which are acid in their properties without being really acids. The ferric, stannic, and auric chlorides are in this category, and the hydric chloride is another normal salt of very acid properties. *Acid salts* are those which contain in each molecule an excess of acid, for example—

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[*] *Annal. der Ch. u. Pharm.*, CI., 303.

$S_2O_7H_2, S_2O_7K_2$, &c., are acid sulphates;
$Cr_2O_7K_2$ is an acid chromate;
$P_2O_7H_4$ and $P_2O_7Na_4$ are acid phosphates.

Basic salts are such as contain the elements of a base added to those of a normal salt; for example,—

$PbCl_2,PbO$, and $HgCl_2,HgO$.

But the bismuthic oxychloride, $BiOCl$, uranic oxysulphate, $UrO(SO_4)_2$, are not to be called "basic salts." There has always been much ambiguity respecting the names applicable to the two chlorides of mercury, that which is soluble being called sometimes the protochloride, and at other times the bichloride, accordingly as the atomic weight of mercury is taken as 100 or 200. The author proposes to get over this difficulty by recommending the universal adoption of the names employed in Gmelin's "Handbook of Chemistry," and calling them the "mercurous" and "mercuric chloride" respectively; and for other combinations a similar nomenclature, if generally introduced, would prove of great advantage. The President then proceeded to define the exact meaning of the terms *atom*, *molecule*, and *equivalent*. An "atom" is the smallest quantity of an element, or group, which can be conceived to take part in any reaction. The word "molecule" is only used to express the smallest quantity of an element, radical, acid, base, salt, or other compound, which can exist by itself out of combination. An "equivalent" is that weight of a body which corresponds, or is equivalent, to one atom of hydrogen, and may be expressed in this notation by a compound symbol, which shows, by a figure below, the value of its atomicity, thus:— $\frac{O}{2}, \frac{N}{3}, \frac{C}{4}$ are equivalents of oxygen, nitrogen, and carbon respectively. A few examples will render the application of these principles more intelligible; thus:—

H =	1	represents	an atom of	hydrogen.
O =	16	,,	,,	oxygen.
N =	14	,,	,,	nitrogen.
C =	12	,,	,,	carbon.
CH_3 =	15	,,	,,	methyl.
CN =	26	,,	,,	cyanogen.
C_2H_4 =	28	,,	,,	ethylene.
NH_4 =	18	,,	,,	ammonium.
CO =	28	,,	,,	carbonic oxide.
SO_2 =	64	,,	,,	sulphurous acid.
Hg =	200	,,	,,	mercury.

The molecules of chlorine, oxygen, nitrogen, phosphorus, arsenic, zinc, mercury, and cadmium are thus expressed—

$Cl_2, O_2, N_2, P_4, As_4, Zn, Hg, Cd$;

and the molecular formulæ of radicals thus—

$NH_3, C_2H_4, (CH_3)_2, (CN)_2, (NH_4)_2$.

Examples of molecules of bases, thus—

H_2O, water, or hydric oxide
K_2O, potash, or potassic oxide
Cu_2O, cuprous oxide
CuO, cupric oxide
$(NH_4)_2O$, ammonic oxide
Bi_2O_3, bismuthic oxide
Fe_2O_3, ferric oxide
K_2S, potassic sulphide
$(C_2H_5)_2O$, ethylic oxide
C_2H_4O, ethylenic oxide

Formulæ denoting molecules of acids, thus—

N_2O_3, nitrous acid
N_2O_5, nitric acid
I_2O_5, iodic acid
I_2O_7, periodic acid
CO_2, carbonic acid
SiO_2, silica, or silicic acid
B_2O_3, boric acid
$(C_2H_3O)_2O$, acetic acid
$C_4H_4O_3$, succinic acid

Formulæ representing molecules of salts, thus—

HNO_3, hydric nitrate
$Fe(NO_3)_2$, ferrous nitrate
$Fe_2(NO_3)_6$, ferric nitrate
$Fe_2(SO_4)_3$, ferric sulphate
H_2SO_4, hydric sulphate
$HKSO_4$, hydro-potassic sulphate
H_3PO_4, hydric phosphate
Al_2Cl_6, aluminic chloride
HCl, hydric chloride
$FeCl_2$, ferrous chloride
$PtCl_4$, platinic chloride

With reference to the last-named substance, Professor Williamson remarked that he had not yet heard it called the "tetrachloride of platinum," which chemists of the Gerhardt school were bound to do in order to act consistently. The author continued his account by displaying the formulæ of a number of minerals, and by showing the application of these principles to the classification of the phosphates, the numerous oxides of manganese, and the organo-metallic bodies; and concluded by laying down some good rules as a guide for the use of plus and minus signs, brackets, &c.; and stated his opinion that the order of arrangement of the elements in a formula should be one of convenience only, thus—

$$Ag(NO_3) + ClK$$

would convey to his mind the simplest expression of the manner in which argentic nitrate was supposed to react upon potassic chloride; and he would use indifferently the symbols KCl, or ClK, as might be most convenient for the purpose in view. The sign of addition, + should never be placed inside a molecule, but be employed to indicate that different substances were added or brought together, and $H_2SO_4 + KNO_3$, means that 98 parts by weight of hydric sulphate are to be mixed with 101 parts by weight of potassic nitrate, or in the proportion of their molecular weights. Respecting vapour-volume, chemists had already agreed to adopt as a unit the volume of 16 parts by weight of oxygen, and the author found it convenient in teaching to take an absolute measurement which could be employed as a starting point in calculations. Professor Williamson's standard volume is 11·19 litres (or 11·2 for all practical purposes), which is the bulk of 16 grammes of oxygen at 0°C., and 760 millimetres pressure. With the aid of this number and the molecular weight of volatile bodies it was easy to calculate the bulk of any given weight in practical problems.

Professor Graham felt sure the Society would appreciate the President's endeavours to place the chemical theory upon a more substantial foundation: for his own part, he felt disposed to acquiesce in every one of the President's suggestions.

Sir Benjamin Brodie thought that instead of perfecting our systems of nomenclature it would be better to get rid of them altogether. The latest efforts in this direction were anything but successful; old substances were called by new names, and such was the perversion of the present age that it now took him a long time to identify the bodies upon which he had himself worked, and he felt certain that his friend, Dr. Hofmann, would often be unable to recognise his own creations. If it were possible to use the symbol for the word, as in the operation of thinking, great would be the advantage. Chemistry was now passing through a phase in its history which other sciences had already gone through: for instance, in mathematics, when curves were few and simple it was possible to attach to each a distinct name, but now the curves had grown beyond the reach of language mathematicians were obliged to divide them into classes, and describe them by giving the equation. He agreed with many of the President's remarks, particularly in his definitions of the atom and molecule, but he would ask what constitutes an acid? Whether carbonic oxide could be distinguished from formic acid? [The President here wrote on the board $C_2H_2O_4$ as the formula of formic acid.] He would prefer to dispense with the term "acid," and merely describe the body as the teroxide of sulphur, the deutoxide of sulphur, &c.—simple names which implied very little theory. Anhydrous acetic acid he usually regarded as the oxide of acetyl. In his opinion, it would be better to leave the consideration of these questions to individual effort and research, and not entrust them to a committee, who would have no power to enforce upon others the adoption of their own theoretical opinions.

Dr. Hofmann said that he had listened with the greatest interest to the important proposals made by Professor Williamson, whose remarks reflected many difficulties which in his lectures he had frequently himself experienced. He had no doubt that many of the President's suggestions would be gladly accepted by his brother chemists; he did not, however, think that his proposal to restore the term "acid" to the anhydrides would meet with the easy acquiescence of those who had consistently vindicated this appellation to the hydrates. Like Professor Williamson, and probably like most teachers, the speaker had frequently felt how desirable it would be to have a simple and easily-definable ratio between the volumes and weights of gaseous bodies. Professor Williamson had pointed out that the weight of 12 litres of oxygen under the normal conditions of temperature and pressure was very nearly 16 grammes. For years past he had been in the habit of putting the ratio of volume and weight before his students in another form. The cubic centimetre of water at 4° C. being 1 gramme, the specific gravity of solids and liquids being invariably referred to water, expressed the absolute weights of 1 c.c. of the several substances. In considering the absolute weights of gas-volumes, it was very desirable to adopt in a similar manner, a weight-unit for gaseous substances, the weight under normal conditions of temperature and pressure of 1 c.c. of hydrogen, this gas having, by universal consent, become the standard of comparison for the specific gravity of gases. Not having as yet arrived at that angelic condition of existence in which names were no longer necessary—a state of things graphically described by Sir Benjamin Brodie that very evening—he had found it convenient to adopt a special name for this weight unit, and he had named it *crith* from κριθή, barley grain, with the secondary signification of a very small weight; a word, they would perceive, constructed somewhat upon the plan of the Latin *granum* or the English "grain." The word "crith" admitted of combinations very similar to those of gramme. 1 *kilocrith* was the weight of 1000 c.c. = 1 litre of hydrogen, exactly as 1 kilogramme was the weight of 1000 c.c. = 1 litre of water. It was obvious, then, that read in kilocriths, the specific gravity of gases represented the absolute weights of 1000 c.c. = 1 litre of these gases at 0°C. and 0·76 pressure. 1 litre of chlorine gas weighed 35·5 kilocriths; 1 litre of oxygen, 16; 1 litre of nitrogen, 14; 1 litre of carbonic acid gas 22 kilocriths. Again, the molecular weights of compounds, read in kilocriths, represented the weights of 2 litres of these compound gases; 36·5 kilocriths was the weight of 2 litres of hydrochloric acid, 18 that of 2 litres of steam conceived to exist at 0°C.; 17, the weight of 2 litres of ammonia. Molecular formulæ of compounds such as HCl, H_2O and H_3N; and even of elements such as HH, ClCl, OO all represented no longer generally the weight of 2 volumes, but the weight of 2 litres of the gases under normal conditions expressed in kilocriths. Indeed, the 2 volume formulæ became 2 litres formulæ. The value of the kilocrith was easily remembered; it was 0·0896 (very nearly 0·09, or less accurately $\frac{1}{11}$th) gramme. The speaker had found the conception of abstract 2 volume formulæ greatly facilitated by this link of transition.

Dr. Miller was ready to admit that the word "acid" had been employed in two significations. We now distinguish between anhydrides and acids (or salts of hydrogen); it would be difficult, he thought, to go back to the use of the term "acid" as being applicable to bodies destitute of hydrogen, and in that case there would be a notable exception in hydrochloric acid.

Dr. Frankland agreed with Sir B. Brodie in the opinion that it would be better to term them oxides only. With regard to the termination "ic," he would prefer that this should be reserved for compounds of greatest atomicity; and in the case of metals having but one basic oxide, he proposed that the salt or other compound should bear the name of the metal without alteration—thus, "sodium sulphate."

Mr. Newlands spoke of the confusion arising from the use of the term "acid" in two senses; it would be well to call sulphuric acid the "sulphate of hydrogen." The speaker advocated the adoption of a type system, such as he had already explained in a contribution to the Chemical News.

Dr. Odling considered that, with deference to Sir B. Brodie's opinion, the recent attempts at nomenclature had been successful, and Dr. Hofmann's results were good proof of this being the case. He believed the retention of the word "acid," in a modified sense, to be perfectly justifiable, and was a natural consequence of the growth of definition.

Dr. Paul could not allow that the original view respecting acids comprised anything more than the sour taste, power of reddening vegetable colours, and of neutralising alkalies. He regarded as disastrous the use of one word to express two distinct ideas, and referred to a want of concordance in opinion as to the exact meaning of the words "dry," "acid," "equivalent," &c.

The President, understanding that Professor Hofmann had come prepared to show them an experiment on combustion, proposed that a portion of the next ordinary meeting should be devoted to the further discussion of his communication, which he was anxious to have fully criticised before replying to the objections brought against it.

Having been put to the vote, this course was accordingly adopted.

Dr. Hofmann, having been reminded by the Secretary that at the last meeting he had promised them an experiment, replied that after the important matter discussed that evening, and at the late hour, it was with reluctance that he addressed the Society. He had, however, heard that the Olympian gods, after diligently attending to their celestial business, were occasionally pleased to come down upon earth and to indulge in the pursuits and amusements of ordinary mortals. These Olympic traditions had been happily revived in the Chemical Society, by Mr. Septimus Piesse. The descent of the gods used to take place in a cloud of lightning. They would remember that at the conclusion of the last meeting Mr. Septimus Piesse had furnished them with a cloud; although late in the evening, he begged permission to supply the lightning. Dr. Hofmann then exhibited some *small paper matches*, which were lately given to him, and said to have been brought home from Japan. He lighted several of these matches, which burned with a small, scarcely luminous flame, a red-hot ball of glowing saline matter accumulating as the combustion proceeded. When about one-half of the match had been consumed, the glowing head began to send forth a succession of splendid sparks. The phenomenon gradually assumed the character of a brilliant scintillation very similar to that observed in burning a steel spring in oxygen, only much more delicate, the indiin the said furnaces."—Petition recorded December 6, 1864.

Notices to Proceed.

1950. Giacomo Felica Marchisio, Baker Street, Middlesex, "An improved apparatus for generating inflammable air for illuminating and heating purposes, and applying the same to the burners."—Petition recorded August 4, 1864.

2031. Richard Archibald Brooman, Fleet Street, London, "Improvements in the manufacture of cast steel."—A communication from Francois Marle Emilie Martin, and Pierre Martin, Paris, France.—Petition recorded August 15, 1864.

2675. Alexander Parkes, Birmingham, Warwickshire, "Improvements in manufacturing compounds of gun-cotton and other vegetable substances similarly prepared; also in the preparation of castor and cotton oils and gum ballata, to be used with, or separate from, such compounds."—Petition recorded November 14, 1864.

2973. Carl Johann Falkman, St. Petersburg, Russia, "Improvements in apparatus for distilling and purifying spirituous liquors, also applicable to the purification of other volatile fluids."—Petition recorded November 29, 1864.

CORRESPONDENCE.

Continental Science.

Paris, December 20.

The use of the magnesium light in photography is exciting a good deal of attention here, and M. Matthieu-Plessy has effected an improvement in the magnesium lamp, which deserves your notice. At the last meeting of our Photographic Society, that gentleman exhibited a very excellent lamp—made, I believe, by Mr. Solomons,—which will prove of much use to photographers, and which, by the way, is susceptible of adaptation to many useful purposes. But under the best of circumstances the magnesium does not always burn evenly, and sometimes goes out at a critical moment. M. Matthieu therefore suggests that the magnesium wire or ribbon should be delivered into a fixed flame of a kind that will not interfere with the photogenic properties of the light, and with this object he uses a small hydrogen flame. You will see that nothing can be easier than to adapt an arrangement of this kind to Mr. Solomon's lamp, which, without it, is an excellent instrument.

You have recently, I see, given some account of Niepce's latest results in chromatic photography, so I need not allude to them further than to say that this eminent photographer has, if all be true, been completely distanced by a rival experimenter in the Mauritius, M. Chambay. The information comes a long way, but who can doubt the truth of it, seeing that it is to be found in a newspaper, the *Cernéen*, published at Port Louis?—and do not all newspapers, the Chemical News included, tell the truth, the whole truth, and nothing but the truth? I will translate a sentence or two:—"M. Chambay has succeeded in fixing colour; the picture is taken instantaneously; the relief and modelling of the figure are marvellous; life circulates under the skin; the colour is unchangeable; and the portraits offer an almost incredible resemblance to the originals. . . M. Chambay is going to Paris with his process, where it will certainly make a revolution." That it will.

Another thing which is attracting considerable attention in Paris just now is the adaptation of electricity to the production of motive force. We have two inventions, one by Count Molin, to which M. Babinet stands sponsor. This is proposed for a boat-propeller, whether by a screw or paddles is not said. I have no details of this scheme, but M. Babinet reports strongly in favour of it. I have little doubt that in the main features it resembles another invention by MM. Bellet and Rouve, who are exhibiting at Versailles a small locomotive driven by electricity. This certainly merits some attention, since the inventors do not seem to claim any extraordinary powers for their machine. They only propose it for carrying light weights, such as letters, by an underground railway; and so it may deserve the notice of some people in London, if Mr. Rammell should fail to raise wind enough to drive his carriages through the Pneumatic Dispatch tubes. The driving-wheel of the engine is made of copper, through which at equidistant intervals pass a series of horse-shoe electro-magnets—twenty in the whole circumference. The current is made to pass successively through these magnets, contact being made and broken by means of two discs at the axis of the wheel. The iron rail attracting these magnets causes the rotation of the wheel, and, in the absence of great weight, the progression of the vehicle at an extraordinary speed. I need not go into the details of the arrangements, since any of your readers acquainted with the subject of magnetism will immediately see what they must be. The batteries, I ought to say, are placed at the termini to save the weight in the carriage, and the current is conveyed by insulated wires running between the rails, and over a roller in the locomotive, which communicates with the interrupting apparatus. A small machine exhibited by the inventors succeeds perfectly, and the plan seems feasible on a larger scale.

I have only one other scientific application to notice, and that is the arrangements for the chimes at the belfry to the Church of St. Germain l'Auxerrois. Chimes are usually melancholy affairs—at all events, for those who live in the neighbourhood of them. That one air played four or six times every day for long years must become wearisome, unless upon some particular occasion, as when the chimes of the old Royal Exchange played "There is nae luck about the house" while the greater part of the building was in flames; or at a country church I remember in England, where "Life let us cherish" is played in the middle of a very large graveyard. Well, M. Colin is about to make the chimes of St. Germain l'Auxerrois lively. They will consist of forty bells, and are to play twice a day, and a new air each time; that is, within certain limits, for, as you know, every new tune requires a new barrel. But M. Colin has invented cheap and light barrels, which are easily made and changed, and will cost only about 250 frs. each. The single barrel of the celebrated chimes at Bruges cost, it is said, 60,000 frs. By means of one of Lenoir's gas-engines the inventor compresses air into a reservoir to a pressure of 2½ atmospheres, and acts on the hammers of the bells by letting out this compressed air. The same gentleman is also trying to adopt electricity as a moving force for the hammers, which, though not perhaps impossible, would be a complicated business.

A report of the Surgical Society of Paris on the construction and arrangements of hospitals has just been published, which may deserve notice in England. The hospitals of Paris are notoriously unhealthy; hardly a patient recovers from a severe operation, and the fatality in all cases is much greater than in the London hospitals, which are far from being what they might be. The recommendation to have a series of detached buildings instead of one huge pile, is, I think, especially worthy of attention, while all the rest are eminently practical and valuable.

"Our Inheritance in the Great Pyramid."

To the Editor of the Chemical News.

Sir,—Having read with much pleasure Professor C. P. Smyth's interesting work entitled "Our Inheritance in the Great Pyramid," and also your review of the same in the last number of the Chemical News, I beg to assure you of my entire concurrence in the favourable opinion you have been pleased to express with regard to this work. At the same time I feel it my duty to point out a couple of errors which you appear to have overlooked, and in directing attention to them I am actuated only by a desire to see correctly stated all the data upon which such important conclusions have been deduced. The *errata* to which I refer are to be found at page 210, where it is stated that the ounce avoirdupois contains "427·5 grains," and the drachm $\frac{1}{16}$th part of this amount, or "26·71875 grains." These numbers should have been 437·5 and 27·34375 respectively. The first I thought was a mistake for which the printer alone was responsible, but as the avoirdupois drachm had been calculated upon the false basis of 427·5 grains to the ounce, it became then evident to me that the inaccuracy must have occurred in the original manuscript; and I send you notice of it in order that so good a book may be purged from errors in themselves trifling and obvious, and which can easily be corrected in a future edition. I am, &c.

December 19. F.C.S.

[The errors herein alluded to did not escape our observation, but were not pointed out in the review, inasmuch as the avoirdupois weights were enumerated only in a table of comparison, and did not constitute an integral part of Professor Smyth's system.—Ed. C. N.]

MISCELLANEOUS.

RENARD *v.* LEVINSTEIN.[a]

Before Vice-Chancellor Sir W. P. Wood.

Mr. Grove, Q.C., opened the plaintiff's case with a brief review of previous proceedings, in the course of which he replied to objections which had been brought against the validity of the patent in dispute.

The first witness called was M. Girard, one of the plaintiffs, who was examined through an interpreter. In answer to questions put by Sir Hugh Cairns, he said that the blue dye in question was the joint discovery of himself and M. De Laire, who worked together with him in the laboratory of the French Mint. The name of the latter gentleman did not appear in the English patent, because he was ill, and unable to come to England at the time it was taken out. At the time the patent was taken out red aniline dye was known in England and France in the solid and liquid form, but better known as a solid. That red aniline would produce the blue if sufficiently purified. To the best of witness's belief the blue dye was new at the time. The quantity of the blue dye made since the patent was taken out was worth from 80,000*l.* to 120,000*l.* All this was made according to the specification, with the exception of a slight modification of the process made at the end of 1862. The modification was in the mode of heating.

Cross-examined by Mr. Jessel: Witness was not in the employment of the French Government when he worked at the Mint. He was pupil of M. Pelouze, who did not give him any information about the aniline dyes. M. De Laire and himself worked on them alone. They were in search of new colours, and in the course of these experiments discovered the mode of making a blue. They took out three patents in France. The dye is now made in France according to the last of the three taken out, on January 2, 1862. They obtain the violet colour first, and pass from that to the blue. The violet was changed to blue by means of diluted hydrochloric acid. The process is as follows:—We take purified red aniline dye and heat it for four or five hours with aniline, and so obtain a violet mass. This, according as we wish to have a mass more or less blue, is treated with acid more or less strong. With very dilute acid for violet, and much stronger acid for blue. In all cases the mass is boiled with the acid. All forms of red aniline dye will answer if they be purified from all foreign substances. We use the aniline of commerce, which does not contain any salt. Some chlorine may be present in the red aniline dye. We used chloride of rosaniline, and other salts as well,—acetate and sulphate, for example. We found they would all answer. We only know the composition of red aniline dyes from the labours of Dr. Hofmann, but the dyes were known before. We used chloride of rosaniline to make the blue, but at the date of the patent we did not know what it was chemically. I can tell now whether I am using the chloride by treating it with sulphuric acid. I received communications from M. De Laire while I was in England to take out the patent.

Re-examined by Sir H. Cairns: Both the French and English patents were taken out before the International Exhibition opened.

Mr. G. De Laire, examined through an interpreter by Mr. Giffard. The evidence in chief of this gentleman was simply confirmatory of that given by the previous witness. He stated, however, that the quantity of the dye they had made was worth 180,000*l.*

Cross-examined by Mr. Aston: I know now that red aniline dye is a salt of rosaniline with an organic or mineral acid. The nitrate cannot be boiled without fear of decomposition. The blue can be made from the nitrate. The arseniate will produce the blue. This salt existed, but was not known at the date of the patent. All the salts were sold as red aniline dye.

Re-examined by Mr. Giffard: As far as I know nothing was known as red aniline dye at the date of the patent which would not produce the blue dye. The substances known as red aniline dye were the chloride and arseniate of rosaniline, probably also the sulphate, and certainly the acetate. The two most commonly used were the acetate and arseniate. The nitrate is no longer known in commerce.

M. Thomas, examined through an interpreter: Is agent in England for M. Renard. Resided in Lyons in 1862, and knows that the blue dye was made in 1862 strictly according to Girard's patent.

Cross-examined: Red aniline dye was put in an iron retort with aniline, and heated for five hours. Then the melt was poured into an enamelled pan, and strong hydrochloric acid was added; a current of steam was then passed through the mixture. This process was repeated several times until the colour was produced. The melt was boiled with dilute hydrochloric acid to obtain the violet—ten parts of commercial acid and ninety parts water—this was to remove any excess of red aniline dye. When blue was wanted, a stronger acid was used. I know it was strong, because it gave off fumes. Three or four things were called red aniline dye in 1862—the acetate, oxalate, arseniate, and hydrochlorate of rosaniline. An excess of aniline is advisable in the operation. I have seen experiments made with toluidine, and saw it succeed very well.

M. B. G. Franc, examined by Mr. Russell: Is one of the firm of Renard, Brothers, of Lyons. We began the manufacture of the blue dye in April or May, 1861. We have since made 200,000 kilogrammes.

Cross-examined by Mr. Jessel: I was concerned with the sale. I know no process but Girard's. I know the works of Dr. Hofmann. In Girard's patent, no mention is made of an arseniate of rosaniline. We made our red dye by heating aniline with chloride of tin. We also made the iodide, and we made the red dye with nitrate of mercury also. In 1861 we used the chloride, iodide, and nitrate of rosaniline. All these were known as red aniline dye, but were sold under the names azaline, fuchsine, and magenta. We bought some benzoic acid, and I think used it, but very rarely. We bought large quantities of acetic acid.

M. J. F. Persoz, examined by Mr. Grove: I know the patent of Girard. The process was new at the date of the patent. The substance known at that date as rouge d'aniline will produce the blue colour if it be pure. Any chemist can purify it.

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[a] Our report is necessarily confined to the scientific part of the evidence. Of the personal matters in dispute we shall take no account.

Cross-examined by Mr. Jessel: The substances known as rouge d'aniline in 1861 included what is now known as the nitrate of rosaniline. The acetate and oxalate of rosaniline were sold as red dye at the same date. In crude red aniline dye there is an excess of aniline and secondary products which must be got rid of. I have tried to make the blue with nitrate of rosaniline and aniline. I must add something with the nitrate. I never used pure aniline; it always contained toluidine. I have tried toluidine mixed with aniline, and always succeeded. Commercial aniline contains various bodies, acetone being one. I cannot say that acetone is driven off at the boiling-point. I never experimented with pure aniline. The chloride of rosaniline will produce blue by Girard's process; so will the arseniate. You cannot produce a pure blue, it will have a violet shade. Blues which look so in sunlight are not so in the spectrum.

M. Cahours, examined by Mr. Giffard: I know Girard's process, and have tried it with rouge d'aniline and commercial aniline, and produced a good blue. The process, as far as I know, was new in 1861.

Cross-examined by Mr. Aston: Up to 1861, no blue had been made from aniline. There was the blue from cinchonine. I have operated upon the acetate, oxalate, arseniate, chloride, and sulphate of rosaniline to produce the blue described by Girard. In the first step I obtained a violet mass; afterwards I boiled this mass with commercial hydrochloric acid diluted with eight or ten times its bulk of water. To produce the blue I have boiled it several times.

Re-examined by Mr. Grove: To obtain the blue I employed one of hydrochloric acid and five of water. To get the violet residue, I would use one of acid to twelve of water.

Dr. Hofmann, examined by Mr. Russell: I know Girard's specification. The invention there described was perfectly new. I have made the colour by following the directions. On the 19th and 21st of last month, in company with Drs. Frankland, Noad, and Redwood, and Mr. Warrington, I made experiments to produce the blue. We used what is now known as acetate, oxalate, sulphate, arseniate, and chloride of rosaniline, and also toluidine. We tested the aniline for acetic acid. The separate salts were mixed with aniline in separate experiments. We used a heat of 165°, or a little above and below. The time required varied. The maximum was five hours. The first result was a violet mass. We then divided the violet into two portions—one to be worked for violet, the other for blue. We diluted commercial hydrochloric acid with a large quantity of water—four ounces of acid to a gallon of water, or about 2 per cent. of acid. With this we obtained the violet residue soluble in acetic acid and alcohol. The time of boiling varied; but I should say half an hour was sufficient. We then boiled the other violet with acid and water, in the proportion of one of acid to ten of water. The product had a coppery lustre, and dissolved in acetic acid and alcohol; the solution dyed silk blue. The acetate of rosaniline required the shortest heating to produce the violet mass, and the chloride the longest. In each case a good blue was produced. With toluidine the process was exactly similar.

Cross-examined by Mr. Aston: I was not aware that nitrate of rosaniline was known as red aniline dye at the date of the patent. I should say the nitrate would produce the colour, but it was not tried. I know acetanilide. I believe it is occasionally found with aniline. The same process which detected acetic acid would detect acetanilide. No acetanilide was found in the aniline we tried. The violet mass, treated as directed in the specification, will produce the blue dye. The shortest time in obtaining the blue dye was half an hour to two hours; the longest, six hours. I cannot say whether you can produce the blue in an hour's time. I first knew acetate of rosaniline in January, 1862. I got it from Mr. Nicholson. We experimented on from two to four ounces of the mixture. I cannot say what salt of rosaniline produced most blue dye. We did not make quantitative experiments. I think the oxalate was known at the date of the patent. No doubt a manufacturer would use acetate rather than chloride.

Re-examined by Mr. Grove: At the time of the patent the distinctions between the salts of rosaniline were not known. I do not know whether the nitrate was ever used. I did not test the aniline separately for acetic acid and acetanilide.

Mr. Abel, examined by Mr. Giffard: I have experimented according to Girard's process, and have had no difficulty in arriving at the results. I have experimented with commercial aniline, and the acetate, oxalate, and chloride of rosaniline. I joined in the experiments on the 19th and 21st of November, and agree with Dr. Hofmann in his statement of the results.

Cross-examined by Mr. Aston: I do not think the double treatment of the crude violet mass is clearly described in Girard's specification. In my own experiments I tried the five salts mentioned by Dr. Hofmann. I had never seen the nitrate. I used commercial aniline, supplied to me by Mr. Nicholson. I tested it for acetic acid, but not for acetanilide. The same test would detect both. The heating to convert the violet into blue occupied an hour. We got the violet in an hour. The production of the violet was the production of the blue in the meaning of the specification. In my first experiment the heating operation only lasted twenty minutes. I have only made two experiments. Reading the specification, and using the substances known at the date as red aniline dye, I cannot tell you any means to produce the blue dye in half an hour. By operating on a large scale perhaps time might be saved.

Dr. Frankland, examined by Mr. Russell: I agree with Dr. Hofmann in his account of the experiments made on the 19th and 21st of November. I noted the time in the experiment with acetate of rosaniline and toluidine. We produced the blue in thirty-five minutes. I do not know a pure blue. I examined a considerable number of blues—aniline, prussian, indigo, and cobalt blues. They have all a shade of red. I made spectrum analyses of the plaintiff's and defendant's blues. The defendant's blue contains, in addition to the blue, a band of green and a band of red. The spectrum of the defendant's blue is the same as those of aniline blue and indigo and cobalt blues.

Cross-examined by Mr. Bagshawe: I never experimented before November 19. We did not use nitrate. When I said the blue dye was produced in thirty-five minutes I meant the violet mass. The hydrochlorate of rosaniline took the longest time. The operation lasted six hours. By the operation I mean the heating with aniline. The washing with acid had still to be done. We tested all the materials we used, which were all furnished by the plaintiffs. We tested the aniline for acetic acid, and that test would show the presence of acetanilide. We stopped at the production of the violet mass, and I cannot say what would have been the effect of heating for "several hours." I have not analysed the plaintiff's blue. The defendant's blue shows in the spectrum a band of green and a band of red, similar to aniline, prussian, and cobalt blue. The bands seemed to be of the same width.

M. Kopp examined (in English) by Mr. Grove: I have followed Girard's specification and produced the result. I employed the time and temperature stated. I have tried the crude nitrate of rosaniline, and it produced the violet and blue. We tried experiments at Lyons with the acetate, arseniate, oxalate, and hydrochlorate of rosaniline, and obtained the violet mass. The violet mass can only mean the crude mass. In Lyons we made no experiments with the nitrate.

Cross-examined by Mr. Aston: I did not dye with the blue obtained from the nitrate. In treating the violet mass with acid you get the blue. You can purify the blue on cloth or silk with acid water. By passing through acid water it is made more blue. I consider all commercial blues have traces of red. Azalcine was made with nitric acid, and the maker was prosecuted for infringing Girard's patent. Azalcine was crude red aniline dye. In producing aniline blue from aniline red, I always treated with hydrochloric acid; many strengths of acids will do, but a weak acid is best. I have not produced the blue dye in thirty-five minutes. I only experimented to see whether working according to the patent I could produce the dye. I heated the mixture of red aniline dye with aniline for five or six hours. Less time will do with the acetate of rosaniline. I obtained a small quantity of violet and a large quantity of blue. If you go above 180° you may destroy the dye, if you do not take precautions to make the aniline flow back.

Re-examined by Mr. Grove: Nearly all the aniline salts will do. Other acids will answer, but hydrochloric is cheapest. Dyers prefer sulphuric because hydrochloric often contains iron.

Dr. Redwood examined by Mr. Drewry: I took part in the experiments of November 19 and 21, and agree with Dr. Hofmann's description of them.

Cross-examined by Mr. Jessel: With the specification in my hand I should have known what substances to begin with. I should have taken red aniline dyes such as were exhibited in 1862. I did not know them in 1861. I find "purified in the usual manner" in the specification, and by referring to patents existing at the time I know what is meant by that. I cannot say that a heat of 155° to 160° is necessary. In some cases it is necessary to boil longer than in others. We could get violet with either strong or diluted acid, but for blue you must have strong.

Mr. E. C. Nicholson, examined by Mr. Russell: I am one of the plaintiffs. So far as I know, Girard's process was new. I have made the blue without difficulty by following the specification, which is quite intelligible to competent workmen. We have worked the patent since July, 1862, and have paid the proprietors 16,000*l*. for royalties.

Cross-examined by Mr. Jessel: We make the blue substantially by this process. If we used glacial acetic acid I should say it was substantially the same thing. We use 20 lbs. of rosaniline, 60 lbs. of aniline, and 4 pints of glacial acetic acid in our first process, and boil for an hour and a-quarter. We go as high as 300° to 360° F., and sometimes to 370°. When the boiling is blue we add 4 pints of glacial acetic acid dissolved in 20 pints of methylated spirit. We use no hydrochloric acid. That is substantially in accordance with the patent. We take the quantity of rosaniline [the colourless base] and glacial acetic acid in the exact proportion to form red aniline dye instead of making it separately. We then heat it with the aniline, and in the course of an hour and a-half it passes through the violet to the blue stage. We then dissolve it in a mixture of glacial acetic acid and spirit. We have 20 lbs. of rosaniline to 5 lbs. of acetic acid. If I used pure glacial acid there would be 1 lb. over, but commercial glacial acid is never anhydrous. We make three qualities of glacial acid, containing respectively 40 and 20 per cent. of water, and no water. We use a mixture of the two former. The patent says you are to boil for five or six hours; we do not boil so long. "Methylated spirit" is not in the patent. I did not tell Dr. Odling anything of the process he was to use in making the blue dye. The "slight modification" which has been alluded to is the use of acetic acid. This is not in the specification, but "red aniline dye" is. Three red aniline dyes are now known in commerce—the acetate, the chloride, and the oxalate of rosaniline. I don't think the arseniate is a commercial article now. Chloride contains some arseniate. I do not know that I could get 20 tons of arseniate, and should stop it if I did. The substance mentioned in Medlock's patent is not sold by us as arseniate, but as acetate. I cannot say that the arseniate was sold at the date of Girard's patent. I did not know of the nitrate till yesterday. I took 7 lbs. of acetate of rosaniline and heated it to 300° to 310° F. with one pound and in another case one and a-half pounds of aniline for an hour and a half. I poured the melt into a copper and boiled it with weak hydrochloric acid—a gallon of acid to twenty gallons of water. I boiled it again until it was blue. The strongest acid I used was one gallon of commercial acid to five gallons of water. The acetate of rosaniline was crystallised. Crystallised acetate of rosaniline was known in the market in 1861. Its composition was known to me in February, 1861, but it was not publicly given to the world by Dr. Hofmann until February, 1862.

Re-examined by Mr. Giffard: Nitrate of rosaniline was not a commercial article. Dyers generally use sulphuric acid, but sometimes hydrochloric. With water only the blue dyes would be a dirty grey blue. At the date of the patent the composition of red aniline was not known.

Dr. Odling, examined by Mr. Russell: I know Girard's patent, and have made the blue by strictly following it. [Produced specimens.] I had some instructions about the dyeing, but not in making the dye. I was told to use hot water, and acidify it slightly with sulphuric acid. I have heard Mr. Nicholson describe his process; and, comparing it with the specification, the only difference is in the length of time the mixture was heated. I received a sample of blue dye and analysed it. The mass was blue dye; but there were traces of red dye and hydrochloric acid. I have no doubt the blue was produced according to Girard's process, or a process substantially the same. I also analysed a sample of "Bleu de Lyons," which confirmed my previous conclusion as to the mode of production.

Cross-examined by Mr. Jessel: The blue I made was made according to the patent. Hydrochloric acid is used to remove the purple from the mass. Not using hydrochloric acid does not make a substantially different process. Sulphuric acid I should say was the same. Acetic acid under some circumstances will do. Alcohol would do, but it would be a loss. There is another difference, three of aniline to one of rosaniline, instead of equal weights. I should not say that any proportions would do. Have only used myself the proportions in the patent. There is a difference in the time of heating. I heated for an hour and a-half, and also for five hours. Following the patent, you would heat for more than an hour and a-half, and I think I made the best blue with the five hours' heating. I used something labelled "Magenta Powder;" it was acetate of rosaniline. I purified the aniline myself; it probably contained toluidine. I used equal weights, according to the patent. I got the blue before boiling with hydrochloric acid. I got violet after heating an hour and a-half. After five hours' heating the mass was blue, but it was still possible to get violet from it. I have experimented with sulphate, chloride, and arseniate of rosaniline, and got violet from each in five hours. The salts were supplied by Mr. Nicholson. I tested them for acetic acid and acetanilide; and the test used would have shown benzoic and most other organic acids. It would have revealed oxalic acid. I have made lots of acetanilide. I say I found hydrochloric acid because I found chlorine. If chloride of rosaniline and acetic acid had been used, I should find chlorine. Chloride of rosaniline and acetic acid will give you an acid solution. I should say it would give both my results. I do not know whether it would contain chlorine, but my impression is that the chlorine would combine with the blue and give chloride of blue. You would get chlorine from salt and water. I should say that hydrochloric acid had been used; but mine was not a positive test. I found a small quantity of red dye. I used an alkali of ordinary strength to detect it. There is a carbolic acid red dye; alkalies do not alter it. Red aniline dye is always altered by alkalies. I used ammonia of the ordinary strength. I have read Gilbee's specification. [Extract read.]

"The invention consists in the manufacture of an improved blue colour, which I call rosaniline blue, and in the process or means to be employed therefor, and is based on the discovery made by Professor Hofmann, of London, that rosaniline was a colouring basic substance, susceptible of producing colouring matters in the greater parts of its combinations. I obtain rosaniline on a commercial scale of a white, rosy, or greyish colour, by treating the salts of its base (which salts are known in commerce by the name of red aniline) in a hot aqueous solution, saturated with caustic alkali, either soda, potash, or ammonia, in the proportion of two parts of alkali to one part of rosaniline salt employed. The mixture is kept in ebullition until the rosaniline in suspension in the liquid no longer loses its colour. I prepare an acetate of aniline by mixing 100 parts of aniline with acetic acid of commerce (40 per cent. crystallisable 20 parts). One part of rosaniline is mixed with 5 parts of this acetate, the whole is heated and kept slightly boiling until the whole mass becomes of a blue colour. To obtain a blue colour with a purple or red tint, the vessel containing the mixture should be removed from the fire directly the desired tint is obtained. The raw blue obtained is poured into a highly diluted solution of sulphuric acid, which must contain a sufficient quantity of acid to saturate the aniline employed in the production of the acetate. I filter the solution to separate the blue formed, then boil it with water several times until the latter is colourless. In cooling the blue separates in the form of a resinous mass, which after being reduced to powder is dissolved in six to eight times its weight of concentrated sulphuric acid: it is then precipitated in a large quantity of water. By drying this precipitate the blue is obtained in the form of a copper coloured powder."

I have never tried that, but I should think it would give a good blue. The process is almost identical with what I have tried, if you put hydrochloric for sulphuric acid. I know Schlumberger's process [Patent No. 117, of 1863]. No doubt it will give a blue. Acetic acid or sulphuric would do for Girard's process; he points out the cheapest or the cheapest but one. I made no experiments with a nitrate of rosaniline.

Re-examined by Mr. Grove: I think my deduction that hydrochloric acid was used in making the blue was correct, because the chloride of blue would be insoluble. This was the first blue known. There is a blue called carbolic acid blue, but it is a questionable substance. Grignon's blue came after. Chinoline blue is very different, and came earlier. Rosolic acid is red.

Mr. Warrington, F.R.S., examined by Mr. Grove. Had analysed samples of blue dyes received from the plaintiffs. Found them to contain traces of red aniline dye, aniline, and hydrochloric acid. Believes them to have been made by Girard's process, or a process substantially the same.

Cross-examined by Mr. Jessel: Sulphuric acid was the chemical equivalent of hydrochloric acid, if it were used to produce an equivalent result. Its use was an evasion if used to obtain the same result. One salt of aniline used for another was an evasion. It was the same with acids used with salts. Whether you made the salts or used salts ready made was the same. [The Vice-Chancellor here remarked that the Lords had decided that the opinion of a scientific witness as to an evasion could not be received.] Made only a qualitative analysis of the dyes. Found hydrochloric acid, but could not say how much chlorine was present. The chlorine might have come from the hydrochlorate of rosaniline. Had made the blue dye from the chloride; it was insoluble in dilute acid, but soluble in alcohol and acetic acid. The red dye could not have been made from carbolic acid or carbolic acid and aniline. Never saw rosolate of aniline. Did not know whether rosolic acid and aniline would make a dye. Rosolic acid was made from carbolic acid; should have found it in the analysis if it had been present. Only found the three bodies tested for. No acetic acid was present. Sulphuric acid would have detected it. Had made experiments with Girard's process, and always succeeded in forming the blue. Used a number of red aniline dyes—five in the experiments—but no nitrate. Used the acetate and then obtained the violet mass in one hour.

Re-examined by Mr. Grove: The heating finished when the violet was obtained. No red was left if the purification was complete. The chloride of the blue was insoluble in water. The treatment with hydrochloric acid removed the red dye and aniline which had escaped transformation.

A clerk of Messrs. Simpsen and Co., and a man who had formerly travelled for the defendants, were now called to identify and prove the delivery of the samples to Mr. Warrington.

Mr. J. W. Speed, examined by Mr. Russell: I am now a dyer at Manchester. Was at Milan with the defendant. Knew Michel and Burdet there, who came from Girard's. They made blue dye at Milan with magenta crystals, aniline, and benzoic acid. They used benzoic acid in the proportion of one-eighth the weight of the aniline.

Cross-examined: Knew Girard's patent. Could only make a blue violet with a tinge of red by the process described in it. Used red aniline dye and aniline, and heated for three hours and a half. Did the best he could, but could only get a blue violet, a purplish blue. Knows the defendant's process, which makes a true blue. Meant the blue made by the process described as the defendant's, but made with magenta crystals, aniline, and benzoic acid, but no other acid.

Re-examined by Mr. Grove: Used hydrochloric acid afterwards and ordinary spirit of wine. Red aniline, rectified aniline, and benzoic acid give a blue when hydrochloric acid and alcohol are used afterwards. He first obtained a dirty blue purple. The melt was procured in half an hour.

By the Vice-Chancellor: The melt, when pressed and dry, was bronze coloured. Spirit gave a blue solution with it.

This closed the case for the plaintiffs.

Mr. Jessel then addressed the Vice-Chancellor on the part of the defendants, contending, first, that Girard's patent was bad on several grounds; and secondly, that the defendant's dye was produced by a substantially different process.

Trinity College, Dublin.—Degree conferred by the Earl of Rosse, Chancellor. Doctor of Medicine, Honoris Causâ: Maxwell Simpson.

Royal Institution.—Tuesday, Thursday, and Saturday, December 27, 29, 31, at 3 o'clock, Professor Frankland "On the Chemistry of a Coal" (juvenile lectures).

ANSWERS TO CORRESPONDENTS.

Dr. Bond.—Mr. Solomon, Red Lion Square.

H. R. C.—The solution generally used for crystallising on glass is a moderately strong one of sulphate of magnesia, thickened with a little gum arabic. Kuhlmann has lately said that sulphate of zinc used in the same way answers the purpose. You may colour the solutions if you please, and obtain very pretty effects. (2.) Reduce with sulphurous acid, and separate by crystallisation.

Book Received.—The Philosophy of Health, by Southwood Smith M.D.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Analyses of Sewage, by Dr. T. L. Phipson, *F.C.S., &c.*

During the last twelve months several samples of sewage have been forwarded to me for analysis, and I have been kindly permitted to publish some of the results obtained. I subjoin a partial analysis of stable manure as a sort of comparison:—

I. Entire Sewage.

	Stable Manure.	House Sewage.	House and Stable Sewage Combined.	Common London Sewage.
Water . .	70·000	98·700	94·400	99·975
Dry residue .	30·000	1·300	5·600	0·025
	100·000	100·000	100·000	100·000
Nitrogen .	0·500	0·117	0·370	...
Or, ammonia	0·607	0·128	0·450	...

No. 1 was an ordinary sample of stable manure; No. 2 was the sewage of a large establishment; it was conveyed into tanks, constructed purposely, instead of into the river; No. 3 was the product of another tank which received both the house and the stable sewage; No. 4 was sent to me with a label "Thames Sewage," but I do not know where it was taken.

II. Sewage Evaporated to a Portable State—Analyses of the Dry Product thus Obtained.

	London.			Wolverhampton.			Edinburgh (obtained by precipitation).
Water . . .	2·50	12·00	18·00	2·80	3·00	9·00	17·00
Organic matter .	71·30	59·50	56·60	70·00	66·00	61·00	20·50
Phosphate of ammonia . .	1·25	1·87	..	2·10	2·00	28·00	..
Phosphate of lime and magnesia* .	5·00	9·50	10·00	6·50	11·40		8·00
Sulphate of lime .	1·50	2·00	..	1·00	2·00		7·00
Alkaline chlorides and sulphates .	7·95	7·13	7·40	7·00	6·50		3·50
Sand . . .	10·50	8·00	8·00	10·00	9·00		40·00
	100·00	100·00	100·00	100·00	100·00	100·00	100·00†
Nitrogen. . .	6·24	6·00	3·43‡	6·16	7·56	7·21	1·65
Or, ammonia . .	7·58	7·30	4·17	7·48	9·18	8·77	2·00

III. Sewage of Carlisle Solidified by Peat Charcoal.

Water	54·75	50·00	38·00	39·00	26·00	51·58
Organic matter . .	22·25	23·00	20·40	19·50	22·80	20·76
Phosphate of lime and magnesia . .	1·25	..	..	1·50§	7·80	27·66
Carbon and silica .	21·50	27·00	41·60	40·00	33·50	
Alkaline salts . .	0·25	..	..	..	8·70‖	
	100·00	100·00	100·00	100·00	100·09¶	100·00
Nitrogen . . .	1·65	1·48	..	2·60	2·67	2·20
Or, ammonia . .	2·00	1·80	..	3·15	3·25	2·60

I should state that none of the above had been subjected to an admixture of impurities from manufactories, &c., and it would, on that account, be interesting to compare these results with the analysis of a fair sample of average London sewage, as it finds its way to the river. I have not yet had an opportunity of analysing the latter.

London, December, 1864.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 15, 1864.

R. Angus Smith, *Ph.D., F.R.S., &c., President, in the Chair.*

The following letter from Mr. James Nasmyth, C.E. addressed to Mr. Joseph Sidebotham, and dated November 8, was read:—

"I had intended to have sent the Manchester Literary and Philosophical Society 'a Paper,' embodying some ideas I entertain in regard to the vast antiquity of the features and details of the lunar surface, but in attempting to put my views on this subject into the formal shape of 'a Paper,' somehow or other my pen won't say what I want it to express, so I am fain to get out of the difficulty by sending you an abstract of my views on this subject in the form of a letter. The views I entertain on the subject in question are these—namely, that as a direct consequence of the small mass of the moon, and its comparatively large surface, it must have parted with its original cosmical heat with much greater rapidity than in the case of the earth, and consequently the moon must have assumed a final condition of surface structure ages before the earth had ceased from its original molten condition. And as the moon had in all reasonable probability never possessed an atmosphere or water envelope (it certainly has none such now), while the earth has both, the action of the earth's atmosphere, and especially that of its ocean when it existed in the first instance as a vast vapour envelope, ere the earth had cooled down so as to permit the ocean taking up its final position as an ocean, this mighty vapour envelope must have retarded the escape into space of the cosmical heat of the earth millions of ages after the moon had assumed its final condition as to temperature. Therefore it is from such considerations I am led to the conclusion that the surface features and details of the moon present to us a sight of objects, the antiquity of which is so vast as to be utterly beyond the power of language to express, and scarcely less so for the mind to conceive. But yet at the same time such considerations appear to me to enhance so vastly the deep interest which ever attends the examination and contemplation of the moon's wonderful surface, that I would earnestly urge those who agree with the soundness of these views to bear them in mind next time they have an opportunity to behold the marvellous details of the lunar surface, as I am fain to think that in doing so the interest of what is there revealed to them will be rendered vastly more impressive."

The President read a paper "*On the Composition of the Atmosphere.*" He believed that his inquiry proved that the oxygen test was a very valuable one, as indicating the condition of the atmosphere. The oxygen was diminished in many cases, and, indeed, in all cases where the air was known to be inferior. He said the objection to such air may perhaps be found not so much in the absence of oxygen as in the gases which take its place. That place was not wholly supplied by carbonic acid. He believed it needful to examine the composition to the second decimal place in the case of oxygen, and to the third or even fourth in the case of carbonic acid, as extremely small amounts of some gases affect us. Hitherto we have had the composition of the air given in numbers varying a tenth per cent.—specimens have generally been taken from rooms on streets or open places indiscriminately. It is the author's wish to show that variations are dependent on the conditions of soil, situation, wind, &c., and that the oxygen and carbonic acid together may with very minute analysis guide us in our sanitary inquiries. The paper cannot easily be given in abstract, further than by adding a table of the analyses showing the average numbers obtained in various places:—

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* Including sometimes about 2·5 of phosphate of iron.

† Add, carbonate of lime, 4·00 per cent.

‡ It is evident here that carbonate of ammonia has been volatilised during the evaporation; hence the necessity of fixing this salt according to Mr. Manning's plan.

§ Including oxide of iron and alumina 0·65.

‖ Including sulphate and carbonate of lime.

¶ Add, oxide of iron, 1·20.

Analyses of Atmospheres varying in Oxygen.

		Oxygen per cent Avge. Nos
N.E. sea-shore and open heath (Scotland)		20·999
Tops of hills (Scotland)		20·98
In a suburb of Manchester in wet weather		20·98
Ditto ditto ditto		20·96
Front of street ¾ths of mile from Exchange, Manchester		20·945
At the back part of the house		20·936
Low parts of Perth		20·935
Swampy places (favourable weather)	20·922 to	20·95
In fog and frost in Manchester		20·91
In sitting-room which felt close, but not excessively so		20·89
In a small room with petroleum lamp, well ventilated		20·84
Ditto after six hours		20·83
Pit of theatre, 11.30 p.m.		20·74
Gallery, 10.30 p.m.		20·36
In large cavities in mines		20·77
In currents		20·65
Under shafts		20·424
In sumps		20·14
When candles go out	about	18·5
The worst specimen yet examined in the mine		18·27
Very difficult to remain in for many minutes		17·2

Analyses of Atmospheres varying in Carbonic Acid.

		Avg. of carbonic acid per cent.
Manchester streets, usual		0·0403
During fogs		0·0679
About middens		0·0774
Average		0·0442
Fogs excepted		0·0424
Fogs and middens excepted		0·0403
Where the fields begin		0·0369
In close buildings		0·1604
Minimum of suburbs		0·0291
Over North Scotland (towns excepted)		0·0336
Candle goes out	1·8 to	2·5000
Lowest found in mines		2·5000
Lowest entered		4·0000

The greater part of this is given in Dr. Angus Smith's report "*On the Air of Mines*"—Appendix to Report of the Royal Mines Commission, 1864.

MICROSCOPICAL SECTION.

First Ordinary Meeting, Session 1864-5.

October 17, 1864.

Joseph Sidebotham, *Esq., President of the Section, in the Chair.*

The **President** stated that he regretted to have to inform the members of the total failure of the efforts made during the last summer to provide them with fresh cotton pods for the purpose of investigating into the structure of the cotton fibre. This was partly owing to ravages of the common greenhouse pest, the red spider, and partly unaccounted for, as the plants had flowered but not fruited. He called the attention of the meeting to the compact form of microscope made by Mr. Dancer to facilitate seaside and other investigations, where portability, combined with means of using the higher powers, was the chief desideratum. A specimen was on the table, and he and other members could bear testimony to its advantages. He also called the attention of the members to the many beautiful forms of insects and vegetable life which were frequently neglected as being too small to be examined by the unaided eye, and yet too large for the ordinary powers of the microscope. He assured the members the use of the present three or two-inch object-glasses would reveal to them many objects of surpassing beauty, which had hitherto only been studied in detail. With regard to the use of such powers as the $\frac{1}{16}$th or $\frac{1}{25}$th, he thought they seemed to have reached the limits of the available power of microscopic object-glasses, as it appears impossible to separate or define lines more numerous than ninety thousand in an inch, on account either of the decomposition of light or some other cause. It therefore seems beyond our power ever to discover more of the ultimate composition of matter by aid of the microscope, even were we not prevented by the material composition of our lenses and organs of vision. We have, however, penetrated to the very confines of organic life, if not beyond, inasmuch as no organisms appear to exist smaller than those we can already see. It is, moreover, a curious fact that the smaller creatures are composed of fewer elements than the larger ones, and that the number of elementary bodies composing them decrease in number as the organisms themselves decrease in size. It becomes, therefore, a matter for speculation whether the reason of this may not be that the ultimate atoms of some elementary bodies are larger than others, and that these, from their size, cannot be used in the composition of the more minute forms of organic bodies, and that smaller organisms than those about $\frac{1}{75000}$th of an inch do not exist, because the ultimate atoms of all solid bodies are too large to be economically used in their formation. The telescope appeared to have infinite fields of distance to explore, but it would seem the microscope had nearly reached the limits of its possible power.

Mr. J. B. **Dancer**, F.R.A.S., then read a paper "*On a Contrivance for Regulating the Amount of Light Transmitted from the Source of Illumination to the Mirror of the Microscope.*" When viewing certain objects by transmitted light, and particularly with oblique illumination, a very slight alteration in the quantity and direction of the light produces a marked difference in the appearance of the object, especially in Diatomaceæ, where a proper management of the light shows lines or markings invisible under ordinary direct illumination. The apparatus now exhibited is one easily made at a trifling cost, and consists of a circular disc of blackened tin or cardboard ten or twelve inches in diameter, with a number of perforations of various shapes and sizes—circular, cross-shaped, wedge-shaped, &c.—the centres of which are about 3¼ inches from the centre on which the disc, placed perpendicularly, rotates. The form of perforations found generally most useful are parallel slits—slits at right angles to each other—wedge-shaped and circular openings. The object under view must be well illuminated in the direction required, and then the disc, supported by a pillar, is placed between the source of light and the concave mirror, when a few trials will determine the best form of aperture. The markings of Pleurosigma fasciola, angulatum, &c., may be seen by its aid under powers which would not show them with any arrangement of achromatic condensers, and it also has the good property of shading all but the amount of light required from the lower portion of the microscopic stage and stand. The disc might be attached to the lamp, but it appears to work better on a stand, and is susceptible of various modifications which will readily suggest themselves to the microscopist.

Mr. W. H. **Heys** exhibited specimens of leaves of the vegetable marrow, showing reticulated markings somewhat similar to those of Symphytum, and presented a slide to the cabinet.

Mr. **Sidebotham** stated that in sweeping over herbage for Coleoptera and other insects, he had found some very curious seeds, to one of which, that of Sanicula Europea, he thought attention had not hitherto been drawn, though well deserving of it. Those of Henbane and Daucus were also most singular.

Mr. **Linton** exhibited the elegant tufted stigmas of

Poterium sanguisorba, and the very singular calyx of the gum cistus, which might almost be mistaken for the skin and scales of a fish.

Ordinary Meeting, November 29, 1864.

R. Angus Smith, *Ph.D., F.R.S., &c., President, in the Chair.*

Mr. E. C. Buxton was elected an ordinary member of the Society.

Dr. Joule exhibited a magnetic needle for showing rapid and minute alterations of declination. It consisted of a piece of hardened and polished watch spring, an inch long and one-tenth of an inch broad, suspended vertically by a filament of silk. The steel was magnetised in the direction of its breadth. He remarked that Professor Thomson had long insisted upon the advantages which would attend the use of very small bars in most magnetical investigations, and had employed excessively minute needles in his galvanometers with great success. Dr. Joule stated his intention to fit up his needle so as to be observed by light reflected from its polished surface, or otherwise by viewing a glass pointer, attached to the bottom of the steel, through a microscope. He believed that by the latter plan he should be able to observe deflections as small as 1" of arc.

ACADEMY OF SCIENCES.

December 19.

A Memoir by M. Houzeau, entitled, "*Study of Arseniferous Hydrochloric Acid*," was read. The author gave the amounts of arsenic he had found in various specimens of the acid, states that the arsenic exists in the acid in the state of chloride, and, lastly, gives a method of purifying the arseniferous acid. This last section of the memoir we shall translate.

M. Margueritte replied to M. Caron in another note "*On the Cementation of Iron by Carbonic Oxide and Carbon.*" The dispute between these gentlemen seems endless.

Mr. Terreil presented "*Analyses of some Minerals from Siam.*" These consisted of two gold ores, an Oriental emerald, some iron ores, and a bituminous matter containing sulphur.

M. Gal presented a note "*On a New General Property of Ethers.*" The author finds that ethers treated with hydrobromic acid split up, forming hydrobromic ether, and setting the acid radical free.

M. Batka gave a new "*Analysis of the Follicles of Senna*," for which we have no space to-day.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2920. G. M. de Bayelt and J. Vigoulête, "An improved method of compounding by agglomeration artificial fuel."—November 23, 1864.

2998. C. Binks, "Improvements in separating sulphur from coal and coke."—December 1, 1864.

3017. J. G. Ulrich, "Improvements in the means and contrivances employed in the packing, conveying, and storing of gunpowder and other explosive materials, to prevent the accidental explosion thereof."

3018. C. W. Siemens, "Improvements in apparatus for the production, purification, and combustion of gases for heating purposes."—December 3, 1864.

3020. J. G. Winter, "Improvements in revolving retorts, and in the mode of applying heat to the same, designed for producing oil from coals, shales, cannels, and other substances, or for distilling oils."—December 5, 1864.

3071. J. Vaughan, "Improvements in heating the blast for furnaces in the manufacture of iron."—December 10, 1864.

3095. J. B. Thompson, "Improvements in coating iron and steel with silver, gold, platinum, or palladium, and in ornamenting articles with such metals."

3101. P. F. Lunde, "Improved apparatus for obtaining extracts from vegetable substances."—December 14, 1864.

Notices to Proceed.

1998. H. Armistead, "Improvements in dyeing and sizing, or preparing warps for weaving."—August 10, 1864.

2003. J. A. and J. Webb, and J. J. Monteiro, "Improvements in the application and in the preparation of certain fibres for the production of paper and textile fabrics."—August 11, 1864.

2026. R. T. Monteith, "Improvements in preserving eggs."—August 13, 1864.

2043. P. A. le Comte de Fontainemoreau, "Certain improvements in the process of preserving animal and vegetable alimentary substances."—A communication from François Xavier Escofet.—August 17, 1864.

2359. L. A. and W. Bryer Nation, "A mode of separating the pitch and spirituous oils from all matters containing them."—September 26, 1864.

CORRESPONDENCE.

The New Aspirator.

To the Editor of the Chemical News.

Sir,—Professor Clifton informs me that the swivel aspirator described as invented by Mr. Dancer, of Manchester, was, in reality, first described by M. Boisgiraud. I am sure Mr. Dancer was not aware of this, and I still feel obliged to him for his device, although, of course, we must keep to the rule carefully to give the first inventor the chief credit. The instrument had gone through two stages previously, in the aspirators of Boswell Reid and Brunner.

I am, &c.

R. Angus Smith.

Manchester, December 10, 1864.

Assay of Tin Ores.

To the Editor of the Chemical News.

Sir,—Agreeably to your request I now send you the particulars of the method of estimating the value of tin-stone by dry assay, which has been frequently practised by myself during the last nine years, and has uniformly furnished correct results with but little expenditure of time and labour. The flux employed is cyanide of potassium, and the method of operating has been usually as follows:—The sample having been carefully selected is first crushed by the hammer in a steel mortar, and then further reduced to powder in an agate mortar. 100 grains is a convenient quantity to be taken for analysis, and it is always advisable to make two independent experiments upon the same sample of ore, with the view of having a control, and the highest result obtained is that upon which I place reliance, since the error must always be on the side of loss rather than excess. A couple of small Hessian crucibles, of about 3 oz. capacity, are prepared in the first instance by ramming into the bottom of them a small charge of powdered cyanide of potassium sufficient to form a layer of about half an inch in depth; the weighed quantities of tin ore are then intimately mixed with from four to five times their weight of the powdered cyanide, and the mortar rinsed with a small quantity of the pure flux, which is laid upon the top of the mixture. The crucibles are then heated in a moderate fire, or over a gas-blowpipe, and kept for the space of ten minutes at a steady fusion;

they are then removed, gently tapped to facilitate the formation of a single button, and allowed to cool. Upon breaking the crucibles the reduced metal should present an almost silvery lustre, with a clean upper layer of melted flux. I have usually taken the precaution of dissolving the latter in water for the purpose of satisfying myself in regard to the absence of any trace of reduced metal or heavy particles of the original ore. There is always contained in the commercial cyanide a sufficient quantity of alkaline carbonate to secure the perfect fusion of the silicious gangue and other like impurities in the tin ore, but the operator should assure himself of the absence of copper and lead in the ore, either by preliminary treatment with hydrochloric acid, in which tin-stone is absolute insoluble, or by testing the button of reduced tin after hammering or rolling for such metallic admixture. I have usually found a minute trace of iron, and sometimes gold in the melted buttons, but not so much as to add appreciably to their weight.

My experiments have sometimes furnished identical results, but I would rather state of this process that when worked with ordinary care it may be relied upon as giving numbers true to within ¼ per cent., and I do not know any other method which exceeds this in accuracy and rapidity of execution. I append a few analytical results taken at random from a number of ores assayed in this manner:—

	Tin per cent.	
	I.	II.
Sample No. 1 . . .	45·6	45·8
,, No. 2 . . .	57·2	57·6
,, No. 3 . . .	68·4	68·7

I am, &c. METALLURGIST.

December 15.

MISCELLANEOUS.

RENARD *v.* LEVINSTEIN.*

Before Vice-Chancellor Sir W. P. WOOD.

(*Continued from page* 312.)

IN the course of Mr. Jessel's speech for the defendant, a question arose upon Girard's patent of 1860. This was for the production of colouring matter simply, not for dyes specially, but an allusion to a blue colour was looked upon as a prior publication of the process of 1861. Some of the plaintiff's witnesses were therefore recalled to prove that the two patents were for substantially different matters. We need not further allude to this part of the proceeding, as it only formed an episode in the trial, but proceed now with the evidence for the defendants.

The first witness called was Professor J. A. Wanklyn, who was examined by Mr. Aston. He said he had considerable experience in the mode of making aniline blue, having manufactured and sold it in Heidelberg in 1862-3. He made the blue in two ways. In one he used the red aniline dye commonly known in Germany; this was the arseniate of rosaniline, and was moist with hygroscopic water. To this he added aniline, and heated. While the mixture was hot he added benzoic acid, and continued the heat for a time until a bronze mass was formed, which was semi-fluid while hot, and solid when cold. He took from time to time a portion out of the vessel, and dissolved it in alcohol, and as soon as the solution was blue the process was finished and the dye was perfect. In general he heated to 170° C., but the temperature might at times be higher, and at times lower. After the benzoic acid was added the process soon came to a close, generally in an hour. The proportions he used were one part of arseniate of rosaniline, one and a-half parts of aniline, but the proportion of aniline was not material, and of benzoic acid one-fourth the weight of the arseniate of rosaniline. These proportions produced a really good blue after purification. He purified with ether, which removed the unchanged aniline and the tarry matters formed; after that the dye was ready for the market. He purified in another way, by treating the melt with alcohol and then with diluted hydrochloric acid; the dye was then washed, separated by filtration, and dried. Or he washed the melt (bronze mass) with acetic acid, and used ether when much tar was present. It was immaterial which method of purification was used. He made many experiments to obtain blue. If the arseniate of rosaniline was replaced by the acetate, an equally good colour was produced. Arseniate of rosaniline, aniline, and acetate of soda also made a good colour. The result was the same with acetic as with benzoic acid, but without either benzoic or acetic acid no bronze-coloured mass was obtained. Benzoate of aniline decomposes at 150°C.; most of the aniline salts part with aniline at 150°C. He knew Girard's specification. Had tried the process in Germany because he wanted to dispense with benzoic acid. With Girard's process very little change took place. He never got blue without benzoic or acetic acid. Had made experiments with Girard's patent in conjunction with Dr. Miller, but did not remain until the experiments were completed. Knew the tests for acetic acid and acetanilide, but had never seen acetanilide. Sulphuric acid would detect acetic acid; small quantities would be detected by the kakodyle test.

Cross-examined by Mr. Grove: Small quantities of acetanilide could not be detected. Has taken out two patents, one of which is completed. Patented the use of benzoic acid in November or December, 1862. Had experimented and manufactured perhaps two or three cwt. of the colour in Germany. A manufactory was started in London in 1863, and is still going on. The defendant, Levinstein, works under a license from me. I do not assist in the manufacture; have made the colour to show people. I have a patent for making purple dyes from manna sugar. Have never seen the operation at work. Have never seen aniline used in the process, but rosaniline in some form or other is used. I don't know the proportions of manna sugar used. Cannot tell the chemical reason why benzoic acid produces the colour quicker, and in operation. Can only say the process goes better. Have patented a purple dye called "Avelia." It is an organic dye.

Re-examined by Mr. Jessel: You cannot get a blue by Girard's process with an inorganic acid and without an organic acid in some form or other either in a salt or free. With an organic acid you get the blue at one operation. The red gradually becomes blue.

Mr. D. Campbell, examined by Mr. Jessel: Is familiar with several aniline dyes, and knows Girard's patent of 1861. Tried experiments with it in 1861 or '62. Obtained a good violet by the first part of the process, but not a true blue by the second. All his experiments with the second part were failures; got only a dirty greyish blue with the chloride; with the arseniate got better. Followed the directions of the specification carefully, and did his best to get the colour. Tried solid and liquid red aniline dyes; tried all the red aniline dyes he knew. The first experiments were made for his own information. First heard of acetate of rosaniline at the Exhibition of 1862. Has heard of the oxalate recently, but is not aware that it is sold now. In 1861 only the arseniate and chloride of rosaniline were sold as red aniline dyes. Made experiments for the defendant with Girard's patent in April, 1864. Got no better results than in his former experiments. Tried acetic acid afterwards, and soon obtained the violet, and afterwards the blue. The violet was obtained immediately, and the blue in about an hour. Had never tried the oxalate. Used equal parts of aniline and acetate of rosaniline; heated them from 320° to 350° F. for an hour.

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* Our report is necessarily confined to the scientific part of the evidence. Of the personal matters in dispute we shall take no account.

Bought red aniline dye of Judson and Sons; got a solution of chloride of rosaniline and used it. Did not get a good colour. Tested the solution, and found no acetic acid, so assumed it was chloride. When benzoic acid was added to the chloride of rosaniline and aniline after they had been heated for some time, you get a blue directly, or in an hour. With arseniate of rosaniline you get the same result, when benzoic acid is used. The result has some red in it, and the blue is not pure, but it is good. Two ounces of arseniate of rosaniline, three ounces of aniline, and a half-an-ounce of acetate of soda heated for three-quarters of an hour gave a blue mass on the addition of twenty-five grains of benzoic acid. The same proportions of the other ingredients, but without the benzoic acid, gave a blue, but not so good. In purifying these, he only heated once for a quarter of an hour with hydrochloric acid. This was to remove the excess of red and aniline. Sulphuric acid would do the same, but hydrochloric is the best. The first part of Girard's patent, using solid acetate of rosaniline, and heating for an hour, gives a blue at once, without any violet stage. Had always bad results with solutions of salts of rosaniline. Tried rosaniline with three times its weight of aniline, and with glacial acetic acid; heated them together up to 330°—370° F. for seventy minutes, and obtained a good blue. The red aniline dyes at the date of the patent were the arseniate and that made with nitrate of mercury. Red aniline dye was always an inorganic salt, unless afterwards converted into an organic. No good dye could be obtained by Girard's specification.

Cross-examined by Mr. Grove: Had made no experiments with the patent of 1860. In experiments with the patent of 1861 used the exact proportions mentioned in the specification. Only knew the chloride and arseniate at the time. The chemical composition of the dyes was not known at the time. Used pure crystals of salt of rosaniline, and dissolved them to see if the solution would answer. Dissolved half an ounce of crystals in ten ounces of water. Obtained the acetate of rosaniline he experimented with from Dr. Miller.

Mr. Crookes, examined by Mr. Aston: Was well acquainted with the subjects of light and colour, and was an early experimenter with the spectroscope. Had subjected colours produced by Girard's specification to spectrum analysis. They were either purple or violet, but not blue. Had applied to a chemist for what was known as red aniline dye at the date of the patent, and had been furnished with a moist red mass. It was a very impure material, and contained mercury. Treated the powder with spirit, evaporated the solution obtained, and used the residue for red aniline dye, "purified in the usual manner." Used half an ounce of this residue and half an ounce of commercial aniline. Did not test the aniline. Mixed the materials in a flask, and heated to 165 C., or as near as possible, for five and a half hours. The result was a solid mass of a bronze colour; boiled this with water and hydrochloric acid—one part of acid to 100 parts of water: obtained a red solution which was thrown away. A residue was left which would dye a violet. Treated this for blue by boiling with hydrochloric acid diluted with ten parts of water; boiled it two or three times. A very small residue was left—not $\frac{1}{20}$th of the ingredients. Dissolved this in spirit: it was more blue than the original violet, but not a pure blue. Examined that solution and others with the spectroscope. Obtained specimens made by Girard's process, and specimens made by the defendant's process, from Dr. Miller. In solution (1 in 250) the blue made by Girard's process was opaque to the orange-yellow and most of the green rays, but transparent to the red and blue. A solution of the same strength of the defendant's blue was quite opaque to red. The defendant's was a pure aniline blue; Girard's appeared to be a mixture of aniline red and aniline blue. The spectrum experiments showed a decided difference between the defendant's blue and Girard's.

Cross-examined by Mr. Grove: The solution (produced) was made with spirit and water. It was a perfect solution, although it might contain some flocculi. Matter in solution and suspension might, in a few exceptional cases, give different effects in the spectroscope. The violet was a mixture of red and blue, and would necessarily be made more blue by getting rid of the red.

Dr. Letheby, examined by Mr. Bagshawe: [The commencement of Dr. Lethsby's evidence was not heard by our reporter.] He had tried Girard's process, and heated the mixture for three or four hours. The result was a dirty violet mass. Indications of decomposition were observed at the expiration of the time stated, so the operation was stopped. Treated the violet mass with very dilute hydrochloric acid. Made a comparative experiment with crude magenta red, and obtained a similar result, but not so bright as in the former case. Treated the mass with stronger hydrochloric acid for the blue; used a solution containing 10 per cent. of commercial hydrochloric acid. Obtained a dirty blue mass which would only dye a dirty blue. Made other experiments with the same proportions of purified magenta and aniline, and one-third the weight of acetate of potash, and also acetate of soda. Heated these mixtures to 165° C. for one hour. With acetate of potash obtained a rich blue at once, which required no further treatment. When acetate of potash is used, believed that the chemical changes which take place are essentially different to what takes place in Girard's process. Benzoic acid acted like acetic in expediting the change. Made no quantitative experiments, but believed that the blue amounted to about one-eighth of the ingredients.

Cross-examined by Mr. Grove: Was not an experienced dyer. In the experiment, which lasted an hour and a-half, obtained a reddish violet mass. The decomposition was shown by the mass turning brown, which showed that there was an end of the profitable change. Did not know the nature of the decomposition. When acetate of potash was used there was a copious evolution of ammonia, but without acetate of potash little or no ammonia was evolved. In the one case the blue obtained is not pure, in the other it is. In following precisely the instructions of the patent there is a great waste of aniline and red aniline dye, and the manufacture would not be profitable.

Re-examined by Mr. Bagshawe: The blue with acetate of potash was obtained without washing; no purification was required. All the material was converted. Could not say whether the products were essentially different or not.

Dr. Miller, examined by Mr. Jessel: Had experimented with Girard's patent of 1861. Used equal weights of arseniate of rosaniline and commercial aniline, and heated the mixture to 160° C. (320° F.) for six hours. Obtained a deep violet mass with a bronze lustre. Boiled the mass with dilute hydrochloric acid, and afterwards with one of hydrochloric acid to ten of water. Did not obtain a blue. Boiled afterwards repeatedly with one of hydrochloric acid to twenty of water until the liquor was colourless. Dissolved the residue in methylated spirit; the solution was purple. The best results obtained by Girard's process was not a good blue. [Specimen produced, which Mr. Grove pronounced to be a good blue.] Had not dyed with the solution. Showed specimens of blue produced with acetic acid; these were much superior. By Girard's process only a small proportion of blue was obtained. In the acetic acid process the whole mass was converted. Had made experiments under directions from the defendant. Heated half an ounce of arseniate of rosaniline, half an ounce of acetate of soda, and an ounce and a-half of aniline to 320°—330° F. from fifty-five minutes to an hour and a-quarter. In both experiments a blue mass with a coppery lustre was obtained. It was purified by boiling with strong hydrochloric acid; and a good blue was procured at once. Tried chloride of rosaniline according to the patent, and get an inferior result. Used various proportions of hydrochloric acid to obtain the best result. Tried nitrate of rosaniline; it answered better than the chloride, but not so well as the arseniate. In one experiment, used half an ounce of arseniate of rosaniline, an ounce and a-half of aniline, half an ounce of acetate of soda, and four grains of benzoic acid. Heated to 310°—340°. In fifty-five minutes the whole mass formed a good blue melt. Treated this with hydrochloric acid, and pressed, and so obtained a bronze mass. Boiled this with water, and washed with fresh hydrochloric acid, until the washings were colourless. The residue gave a beautiful bright blue dye. In another experiment, heated the same mixture to a lower temperature, but for a longer time, and did not obtain so good a result, although the dye was good. Had made an experiment with one of acetic acid, four of rosaniline (the pure base), and twelve of aniline; heated them to 350°—370°; and in seven minutes obtained a blue. There were several points of difference between the process with acetate of soda and benzoic acid and the patented process. In the first case, the melt was blue, and not violet; the blue was obtained in an hour or less, instead of six hours; no purification with strong hydrochloric acid was necessary. The organic salts of rosaniline were not known at the date of the patent. The best known salt was the arseniate. Never saw any blue produced in the arsenic acid process for magenta. Did not know that arsenic acid with excess of aniline would produce blue.

Cross-examined by Mr. Grove: Obtained the best colour with acetate of soda and benzoic acid. That colour did not seem violet. There were no absolutely pure colours in nature. [Nothing of importance was elicited in the remainder of Dr. Miller's cross-examination; but it may be worth mentioning that in course of it a question arose as to what degree Centigrade was equal to 320° F. Several chemists in court volunteered to calculate this, and the following were some of the results called out:—140° C., 145° C., 143° C., 160° C.]

Hugo Levinstein, examined by Mr. Aston: [In order to get the whole of the evidence into this volume, we are compelled to omit all but that part of the defendant's evidence which is most important to our readers.] Has been a maker of aniline and other colours for some years. Is not a scientific chemist; employed chemists. Had tried Girard's process at Milan, but never succeeded in getting a good colour by means of it. In his own process uses the base rosaniline, sometimes, also, hydrochlorate of rosaniline. In both cases he mixes acetic acid in the vessel. Does not add commercial aniline, but uses the waste product which distils over in making magenta red. This waste product will not make red aniline dye; does not give a trace of red. It is not the form in which aniline is sold. Aniline of commerce will make red aniline dye. Did use a small proportion of benzoic acid, but does not now. Uses acetate of soda and glacial acetic acid to form the melt. The proportion of glacial acetic acid was one-fourth the weight of the red aniline base. Heated, according to the proportion of acetate of soda, from half an hour to an hour. Gets in this way a perfect blue, which may be purified by sulphuric or hydrochloric acid. Sells it impure in England. Does not use hydrochloric acid in England. Uses sulphuric acid to precipitate the colour, and then boils with more glacial acetic acid and alcohol. One ounce of the acid to a pint of alcohol.

We omit the cross-examination by Mr. Grove, as very little of it bore on the scientific points in dispute, to which our report is confined.

Mr. Bagshawe summed up the evidence for the defendant, and was replied to by Mr. Grove. We understood the Vice-Chancellor to express an opinion in favour of the validity of Girard's patent; but he reserved his decision as to the alleged infringement.

Science in the Witness-Box.—A writer in *Blackwood's Magazine* makes the following remarks on the examination of scientific witnesses in courts of law:—"The grandest achievement of all is a poisoning case—something that is to be two-thirds emotional and one-third scientific—where the interest vacillates between the most powerful passions and the pangs of arsenic; and the listener is alternately carried from the domestic hearth to the laboratory and back again. Now, when one is aware that the 'learned Serjeant' knows as much about chemistry as a washerwoman does of the 'wave theory,' the display of impromptu learning he makes is positively astounding. Armed with an hour's reading of Beck and Orfila, the great man comes down to court to puzzle, bewilder, and very often to confute men of real ability and acquirement; to hold them up to the world as hopelessly ignorant of all that they had devoted their lives to master; and in some cases to exhibit the very science they profess as a mass of crude disjointed facts, from which no inference could be drawn, or a safe conclusion derived. . . . A pitiable spectacle is that poor man of science, pilloried up in the witness-box, and pelted by the flippant ignorance of his examiner! What a contrast between the diffident caution of true knowledge, and the bold assurance, the chuckling confidence, the vainglorious self-satisfaction, and mock triumphant delight of his questioner! Mark the practised leer, the Old Bailey grin with which he comments on something that science still regards as uncertain or obscure, and hear him declare to the jury that, in the present state of medical knowledge, there is not a man in court might not be indicted for having handed the salt or the mustard to his neighbour!"

Detection of the Adulteration of Arrowroot with Potato or Corn Starch.—According to J. F. Albers (*Arch. de Pharm.*), this is effected with certainty by means of their behaviour towards hydrochloric acid. When one part arrowroot is shaken with three parts of a mixture of two parts hydrochloric acid of 1·12 sp. gr. and one part of distilled water, at ordinary temperatures, for about three minutes, no reaction is observable. But should corn starch be subjected to this treatment, it becomes changed into a gelatinous, translucent, and finally into a semi-fluid mass. Potato starch behaves in the same way, with the production of an easily recognised and characteristic smell. If a mixture of arrowroot with one or more of these substances is to be dealt with, the arrowroot is to be separated by treating the whole for two to three hours with the hydrochloric acid, by which the arrowroot becomes soluble, and may be filtered from the remaining softish mass, which when washed, dried in the air, and weighed, shows by the loss in weight the amount of arrowroot present.

ANSWERS TO CORRESPONDENTS.

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M. Leduc.—Mr. Solomons, Red Lion Square, London, will furnish it.

O., Belfast.—It was read before the Royal Dublin Society, and printed by M'Gill, of the Dublin University Press, from whom you will probably be able to procure it. The writer is thanked for his suggestion.

Magenta.—The decision has not yet been given.

Received.—C. R.; R. T. Clarke.

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